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Cover

Nuytsia floribunda (Labill.) R. Br. ex Fenzl (Loranthaceae) – the Western Australian Christmas Tree is one of the few arborescent mistletoes in the world. This endemic tree is a semi-parasite common in sandy soil from the Murchison River to Israelite Bay. The journal is named after the plant, which in turn commemorates Pieter Nuijts, an ambassador of the Dutch East India Company, who in 1627 accompanied the “Gulde Zeepard” on one of the first explorations along the south coast of Australia.

Cover design by Sue Marais

Photograph A.S. George

Contributions to Western Australian orchidology: 1. History of early collections, taxonomic concepts and key to genera

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“I observe that Dr Lindley considers both my single-flowered Drakeas as identical, and calls the species *elastica*; but they are perfectly distinct. I have named them *D. livida* and *D. lucida*, and can discriminate them at first sight, and as far off as the plants are discernible, with unflinching certainty, when in the growing state, though even I am puzzled to detect the difference when they are dried.”

Drummond (1842: 628)

“To include a great number of very distinct varieties under one species cannot, if it be possible to avoid it, be satisfactory.”

Fitzgerald (1882)

Abstract

Hopper, S.D. & Brown, A.P. Contributions to Western Australian orchidology: 1. History of early collections, taxonomic concepts and key to genera. *Nuytsia* 14 (1): 1–26 (2001). This paper provides a general introduction to a series on the taxonomy of south-western Australian orchids, as well as a new key to genera from this region. The series is based on extensive field and herbarium studies completed over the past two decades. It focuses on *Caladenia* R. Br., *Drakaea* Lindl. and allied genera which have many previously unresolved polymorphic species complexes of the kind alluded to by Drummond and Fitzgerald in the above quotations.

Conducted in collaboration with members of the Western Australian Native Orchid Study and Conservation Group, the series is a contribution towards the bicentennial celebration of Archibald Menzies' pioneering collections of Western Australian orchids in 1791. The series will describe several taxa considered threatened, and validate manuscript names used in the second edition of Hoffman & Brown's "Orchids of South-West Australia".

In addition to conventional examination of herbarium specimens, new techniques for documenting population variation in living material have greatly facilitated the resolution of geographically and ecologically variable species complexes. These techniques include placing fresh dismembered floral

parts on system cards beneath clear magic tape, field tests for pollinator specificity, and the extensive use of 35 mm colour slides and line drawings of fresh flowers. We have also benefited from access to recently acquired data on allozyme and DNA markers.

The early history of the systematics of south-western Australian orchids is reviewed here. It comprised two phases: (1) the first encounters by Europeans and (2) the early colonial phase in which James Drummond was prominent. The strong reliance of taxonomists on the collections and observations of interested resident orchid enthusiasts is a recurrent feature of this history.

Our taxonomic concepts for genera, species, subspecies and hybrids are described. New taxa are considered to be species if they grow in populations (i.e. are not aberrant individuals within normal populations), if they have features or a combination of features not seen in any previously named species, and especially if they grow with previously named species and produce few or no natural hybrids. Geographical races with minor morphological differences are recognized as subspecies. These may hybridize and intergrade extensively where their geographical ranges overlap. Our emphasis on biological as well as morphological attributes in recognizing species and subspecies is a significant change from past practice. It leads to the recognition of more species within complexes previously treated as single polymorphic species (e.g. *Caladenia filamentosa* R. Br., *C. huegelii* H.G. Reichb.). There are many practical advantages to our approach, including improved management for conservation, improved cultivation, and more precise communication and conduct of popular and scientific studies on south-western orchids. New genera, published elsewhere, are based on numerical analyses of morphological data, as well as the recently completed DNA sequence studies of Kores *et al.* (2000, 2001).

Introduction

Two centuries ago, Archibald Menzies, surgeon and naturalist aboard the *H.M.S. Discovery*, was the first European to make collections of Western Australian orchids. The *Discovery*, under the command of Captain George Vancouver, was anchored in King George Sound from 28 September to 11 October 1791.

Menzies made a "copious collection of ... vegetable productions, principally the genus *Banksia*, which are here very numerous" from various sites onshore in the vicinity of present-day Albany (Maiden 1909; Heberle, undated). Three orchid species were subsequently named from Menzies' specimens, including one bearing his name – *Leptoceras menziesii* (R. Br.) Lindl., *Caladenia flava* R. Br. and *Diuris longifolia* R. Br. (Brown 1810; Lindley 1830–1840). The present series of publications, based on more than two decades' research, contributes towards the celebration of the bicentenary of Menzies' pioneering collections. Here, we provide a general introduction to the series, and a new key to genera of south-western Australian orchids.

South-western Australia is one of the few regions in the world where the abundance and diversity of terrestrial orchids may be breathtaking (Hoffman & Brown 1992, 1998). In some habitats, particularly the first spring after a fire, more than 40 species have been recorded in a few hectares, in some cases so abundant that walking without treading on them was impossible. But such situations are exceptional. Indeed, most residents and tourists, professional botanists among them, overlook orchids and underestimate the rich diversity found in the south-west. There are several reasons for this.

It takes many years' field experience before proficiency is developed in locating the best orchid haunts, and it takes longer to ensure seeing all of the rarest taxa. For example, even within Kings Park, located in the heart of Perth city, the orchid list continues to grow, from 28 species a decade ago (Bennett 1988) to 49 species seven years later (Hopper & Brown 1995) and 52 species by 1999. Some genera have small inconspicuous flowers that are easily overlooked in the riot of colour proffered in spring by the larger perennial vegetation. Some orchids rarely flower at all except after fire at the appropriate time and intensity. Cryptic flowering reaches its zenith in the south-west with the Underground Orchid, *Rhizanthella gardneri* R. Rogers, an epiparasite whose elusive subterranean inflorescences take an average of nine person-hours to locate within known sites (Dixon & Pate 1984; Dixon *et al.* 1990).

Some groups of orchids display a bewildering array of variation in floral morphology. Rapid geographical or ecological replacement of closely related variants occurs, comparable to that seen in *Eucalyptus* (Brooker & Kleinig 1990; Brooker & Hopper 1991), *Acacia* (Maslin 1975), *Verticordia* (George 1991), *Drosera* (Lowrie 1987, 1989, 1998), *Conostylis* (Hopper *et al.* 1987) and other species-rich genera in the south-west.

Unfortunately, until the recent publication of Hoffman & Brown (1992, 1998), the available field guides to south-western orchids (Pelloe 1930; Erickson 1965; Hoffman & Brown 1984) provided useful information only on the relatively invariant taxa. They were of little help in understanding and placing names on the plethora of variants encountered throughout the region for species complexes such as those typified by *Caladenia filamentosa* R. Br., *C. patersonii* R. Br., *C. huegelii* H.G. Reichb., *Pterostylis nana* R. Br. or *Diuris longifolia* R. Br.

Given these challenges to the most adept field botanists, and the paucity of professionals resident in Western Australia, it is perhaps not surprising that many recent discoveries of south-western orchids have been made. A wealth of new taxa continues to be identified each year as the results of detailed studies of species complexes come to hand. Just as Jones (1991: 1) remarked that, in relation to his major contribution on eastern Australian Orchidaceae, "to those associated with this research and familiar with complex groups within the Australian Orchidaceae, the description of more than one hundred new species in this paper will come as no surprise", a similar situation prevails in south-western Australia. Much more still needs to be done on the region's orchid flora before a full understanding of the taxa present can be achieved.

Two key elements have contributed to the current advances in south-western orchid systematics. Firstly, over the past two decades, the Western Australian Native Orchid Study and Conservation Group has developed and flourished as a training ground for an increasing number of skilled orchid enthusiasts and photographers. A useful dispersion of country members intimately familiar with the orchids of their districts has facilitated the location and identification of many undescribed taxa. Close involvement of professional orchid taxonomists with the Group, commencing with A.S. George and continuing with ourselves, D.L. Jones, M.A. Clements and R. Bates, has led to a productive and more rapid advance in formal systematic research than would otherwise have been possible. The rise over this same period of the Australian Orchid Foundation, a private funding agency dedicated to promoting the cultivation and scientific study of orchids, has further facilitated this interaction between orchid enthusiasts and professional researchers (e.g. Clements & George undated).

And secondly, new approaches to studying variation in orchid populations have substantially overcome taxonomic problems in dealing only with conventional herbarium specimens. Much of the structural detail, colour and odour of south-western orchids is so distorted by pressing and drying specimens that many taxonomic characters are lost to the herbarium botanist (see Crisp 1993 for a

similar example in the pea genus *Sphaerolobium*). Additionally, observations on habitat, population variation, flowering phenology and pollination are also commonly scant or absent on herbarium specimen labels.

Botanists in Britain and Europe in the 1800s had only a small number of poorly preserved herbarium specimens to work with when they commenced naming south-western orchids. This has meant that much of our current nomenclature is based on broad species concepts developed by taxonomists trying to make the best judgements they could on the limited characters detectable from the available material. Drummond (1842) was the first to allude to the resultant frustration felt by resident field botanists who could readily discern distinct species that were lumped under the one name by botanists from afar (see opening quotation).

The most striking example of such a broad species concept was Bentham's (1873: 381–382) notion that all taxa in the *Caladenia patersonii*, *C. longicauda* Lindl., *C. dilatata* R. Br. and *C. huegelii* complexes belonged to the one species, *C. patersonii*. Bentham commented in support of this view that *C. patersonii* was:

“Very variable in the length and proportions of the sepals, in the shape of the labellum and its fringes and calli, and in the colour of the flowers, which are usually of a pale greenish hue outside and yellowish or pink inside, the calli and end or middle lobe of the labellum usually and sometimes the whole disk of a rich purple. The following are the principal forms this species assumes, regarded by Lindley and others as distinct species, but passing too gradually into each other to be clearly marked out from dried specimens.”

He then went on to recognize the *Caladenia dilatata* complex as a variety distinct from the rest of *C. patersonii*.

James Drummond, Western Australia's first resident European field botanist, collected and separately numbered several of the new species named in the present series, and even described and named some himself in published letters to Hooker (Drummond 1842), only to see some of his observations ignored and specimens lumped under the broad species concepts of the botanists to whom they were shipped.

Bentham's (1873) and particularly Reichenbach's (1871) broad concepts were also recognized as unworkable by Australia's first resident orchidologist, R.D. Fitzgerald. Having seen and accurately painted fresh flowers of many taxa in New South Wales and some from Western Australia, Fitzgerald (1882) remarked rather caustically:

“Specimens that, if submitted a few years ago to the highest authorities, would without doubt have been considered as representing new species, are now matters of hesitation, uncertainty, and re-comparison, and are finally pronounced to be varieties, very often to the disgust of the collector, who has seen them in a fresh state, and who cannot accept the ruling that they are identical with others previously named, with which he may be equally familiar, and into which he feels confident they never lapse.”

Thus, Fitzgerald (1882) recognized *Caladenia patersonii* and *C. dilatata* as distinct species, a view that has been accepted by all authors subsequently. What has happened since has been a growing

recognition that there is also remarkable variation within species complexes such as those typified by *C. patersonii*, *C. filamentosa*, *C. dilatata* and *C. huegelii*.

Taxonomists in the first half of the 1900s began to tease apart this variation, slowly at first, with the recognition of new species and varieties by Domin (1912), Rogers (1909, 1920, 1923, 1927a, 1927b, 1938), Coleman (1930), Nicholls (1947, 1949, 1950) and others. Because much of the work of these authors was done without reference to the type specimens used by their British and European predecessors, some confusion and redescription of previously named taxa resulted. George (1971a), and more recently Clements (1989), Jones (1991) and ourselves (present series), have clarified most of the resultant nomenclatural problems relevant to south-western orchids.

Most modern Australian authors over the past two decades have achieved a thorough understanding of some orchid species complexes through the application of techniques additional to conventional study of herbarium specimens (e.g. George 1984; Jones & Clements 1987, 1989; Bates 1989; Clements 1989; Carr 1986, 1988; 1991; Jones 1991, 1998). These techniques include:

- observation of populations of living plants of taxa in the wild, and recording details of their odour, colour, and three dimensional structure, as well as noting features of the landform, soil, associated vegetation, fire response, phenology and pollinator activity - field studies have become far more comprehensive in recent decades with an improved road system and the ready availability of four-wheel-drive vehicles;
- tests of pollinator specificity by choice experiments using bait flowers of different taxa (Stoutamire 1974, 1975, 1981, 1983; Bower 1992, 1995, 1996);
- preserving flowers and leaves from each sampled population by dismembering, flattening and separately mounting in rows the petals, sepals, labellums and columns beneath clear magic tape on a system card; this procedure results in minimal shrinkage and loss of colour, exposes structure like calli for ready examination, and enables easy measurement of variation within and between populations (Figure 1);
- taking 35 mm colour slides of representative flowers of each population sampled;
- illustrating representative specimens of each taxon from fresh material;
- growing plants in cultivation to study their phenology and morphology under greenhouse conditions;
- testing taxonomic concepts through the analysis of genetic data sets using allozyme markers, DNA sequences etc. (e.g. Figure 2).

In the present study we have used these techniques, together with examination of relevant specimens in the major Australian herbaria, as well as types (or high quality photos of them) from three European herbaria (BM, K and W).

System card collections of floral parts have been particularly useful in helping to resolve geographically and ecologically variable complexes. This technique has potential for systematic studies of any plants with delicate floral parts prone to withering on conventional pressing and drying (e.g. fringe lilies (*Thysanotus*), triggerplants (*Stylidium*), sundews (*Drosera*) and peas). We are indebted to David Jones of the Australian National Botanic Gardens for introducing the technique to us.

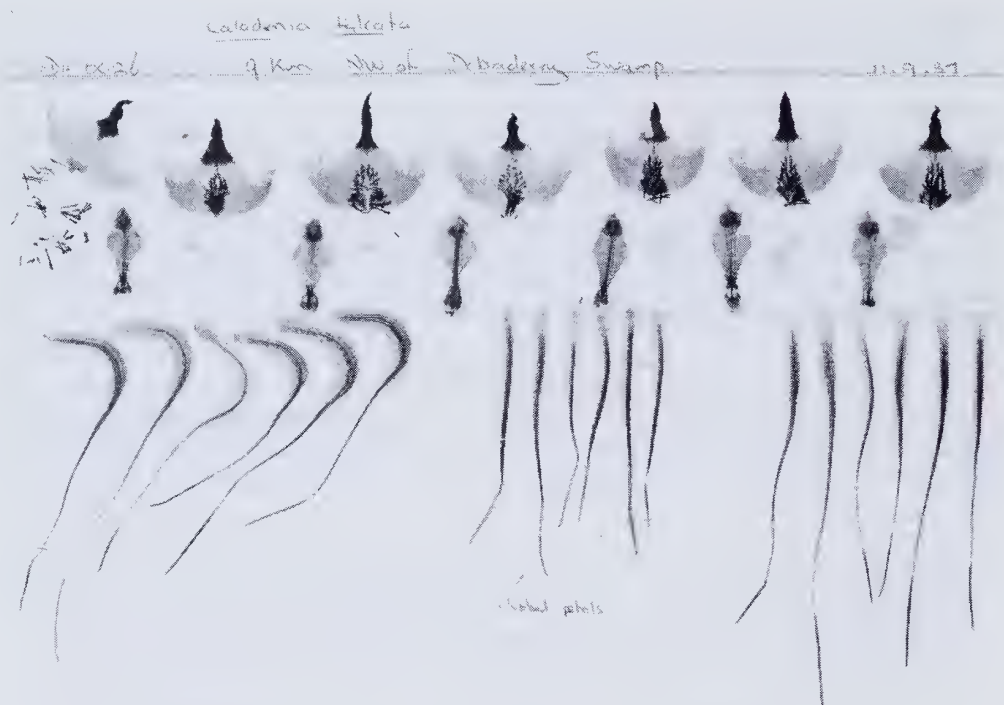


Figure 1. System card showing dissected specimens of *Caladenia falcata*.

In this series and a previous paper (Hopper & Brown 2000), we concentrate on new and reinstated south-western taxa in *Caladenia* R. Br., *Drakaea* Lindl. and allied genera. David Jones and Mark Clements have described and will be describing many new taxa of south-western *Pterostylis* R. Br., *Diuris* Sm., *Cyrtostylis* R. Br., *Gastrodia* R. Br. and *Corybas* Salisbury (e.g. Jones & Clements 1987; Clements 1989; Jones 1991). In South Australia, Robert Bates is currently working on *Prasophyllum* R. Br. and *Microtis* R. Br. (e.g. Bates 1984, 1989, 1990), while work begun by the late Joe Weber of the State Herbarium, Adelaide on *Thelymitra* Forster is now being continued by Jeff Jeanes. We would expect the description of many new taxa in these genera when further detailed population studies are undertaken.

It is timely to describe the new taxa for several reasons. Many are rare, and their formal description will aid conservation agencies in identifying and managing the few populations known (Hopper *et al.* 1990; Brown *et al.* 1998). Our taxonomic research is ongoing, but many undescribed taxa were identified some years ago (e.g. Hoffman & Brown 1984) and are well known among local orchid enthusiasts. Publication of the names will facilitate communication and increase awareness of the real wealth of orchids occurring in the south-west. And finally, the names will be validated following their informal mention in the revised editions of "Orchids of South-West Australia" (Hoffman & Brown 1992, 1998).

While we regard the descriptions in the other papers of this series as a significant new contribution to knowledge of the south-western genera treated, it is by no means the last word on the subject. As our taxonomic research is ongoing, we would welcome hearing from anyone who has found orchids that do not match those illustrated and described in this series or in Hoffman & Brown (1992, 1998).

Combined *matK* and *trnL-F* tree of Diurideae

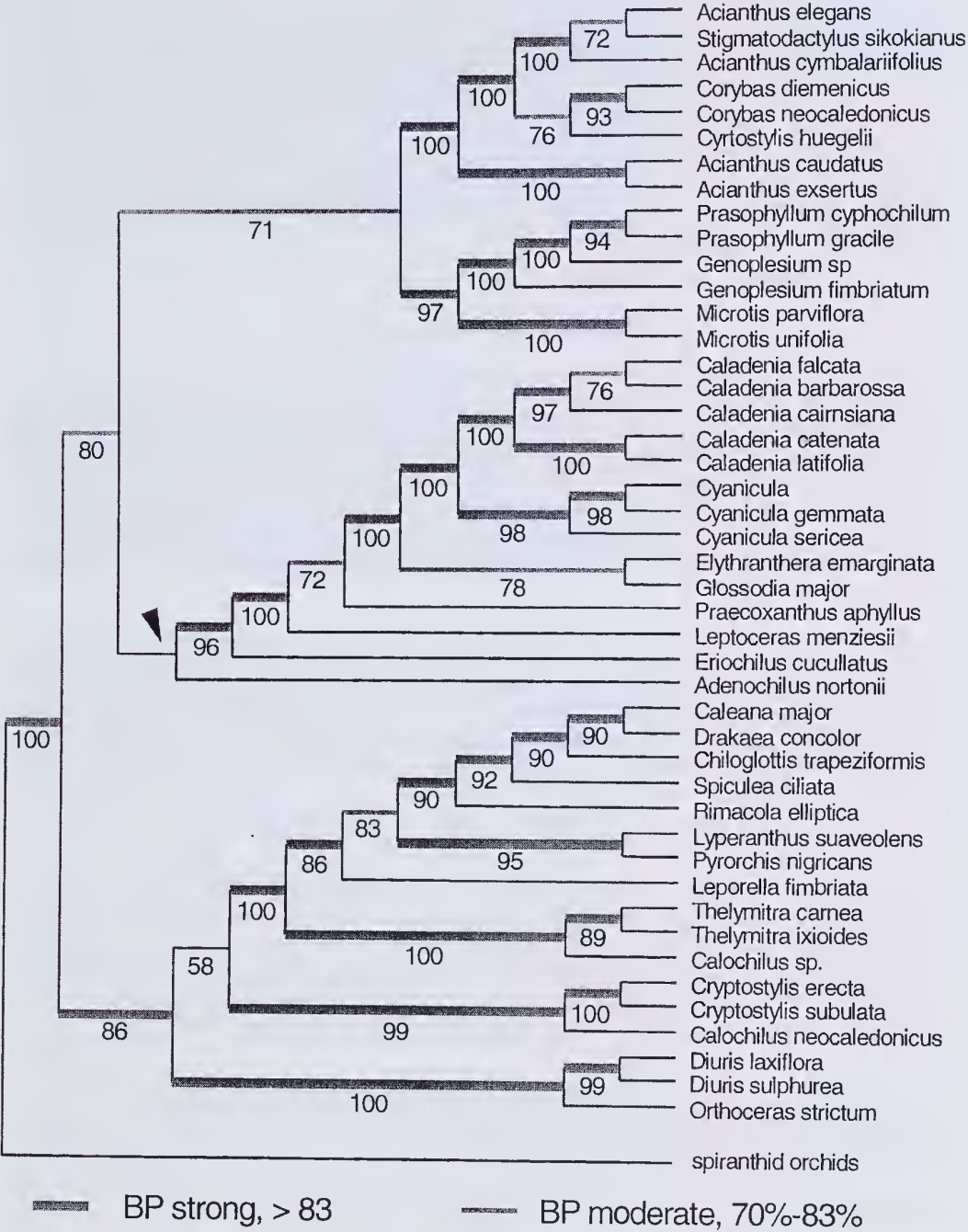


Figure 2. Evolutionary relationships of the Orchidaceae, based on DNA sequence data of three genes (Kores *et al.* 2001). Numbers of nodes are bootstrap values, with 100 meaning 100% confirmation of the node over 100 replicates.

Finally, the current surge in taxonomic research and description of Australian orchids is not without its critics (e.g. Heberle 1995; Dockrill 1995 – see Bower 1995 for an independent response). This is not unexpected, and indeed, is healthy for any area of scientific research. As long as criticism is based on careful testing and well documented falsification of taxonomic hypotheses, significant improvements in our knowledge of Australian orchids will occur. Indeed, such an approach led Bates and Weber (Weber & Bates 1978, 1986; Bates & Weber 1990) to move from early unworkably broad species concepts to a taxonomy much more in tune with biological reality. There will never be a final word on matters such as taxonomic rank and species concepts. The important advances nevertheless will occur primarily when new contributions to existing data are made by careful well-documented study. We would cite the exciting new insights gained on the evolution and classification of all organisms through the recent application of DNA sequence analysis as an especially significant example of a major advance in knowledge (see below).

Systematic history – the pioneers

Given the bicentennial celebration to which this paper is dedicated, it is fitting to review the early history of the systematic description of the south-west Australian orchid flora, focussing on the genera treated herein. We have drawn our information from several sources, the main ones being Diels (1906), Maiden (1908, 1909, 1921), Erickson (1969), Hall (1978, 1984), Carr & Carr (1981a, b), Marchant (1982), Heberle (undated), Short (1990), Barker & Barker (1990), and transcripts of James Drummond's letters to Hooker held at the Western Australian Herbarium. We have also examined specimens in the major Australian herbaria and at Kew, the British Museum and Vienna to obtain additional information on collectors.

At the outset, we wish to stress Barker & Barker's (1990) thesis that throughout the history summarised below, right to the present day, knowledge of the real contribution of all involved in the collection and naming of Australian plants, orchids included, is imperfectly recorded. Proper acknowledgment of assistance is very much a personal matter. Botanists from all ages have varied greatly in their ability and willingness to record their debt to other people. Along with Barker & Barker (1990), we have attempted to recount details of the efforts of poorly known enthusiasts as much as those of the well known botanists whose contributions rightfully have been extolled in the literature.

Four main overlapping phases may be recognized in the collection and description of south-western orchids by Europeans and their Australian descendants – (1) first encounters, (2) early colonial, (3) eastern Australian taxonomists, and (4) resident Western Australian taxonomists. Here we review only the first two of these phases, both mainly involving description of orchids by European botanists, with the most notable feature of the second phase being the outstanding contributions made by James Drummond in the 1830s. It is hoped to review subsequent phases in a future publication.

Because so little has been recorded, we have not attempted to describe aboriginal knowledge, but it must have been prodigious given the 40 000+ years of their occupation of the south-west, and the importance of some orchid tuberoids as dietary items.

First encounters

Orchids may have been seen, but were not collected, when Willem de Vlaming briefly landed on Rottnest Island and the adjacent mainland (now suburban Perth) in December 1696 and January 1697 (Playford 1998). Similarly, the fragmentary collections available from William Dampier's exploration

of Shark Bay and its islands in August 1699 do not include *Eriochilus dilatatus* Lindl. subsp. *dilatatus* and *Pyrorchis nigricans* (R. Br.) D.L. Jones & M.A. Clem. (George 1971b; Burbidge & George 1978; Keighery 1990).

As already highlighted, the first recorded collection of orchids from Western Australia was that attributed to Archibald Menzies in 1791 on the south coast at King George Sound. Menzies or his party collected the types of *Caladenia flava*, *Diuris longifolia* and *Leptoceras menziesii*.

The first genus of orchids occurring in Western Australia to be named by Europeans was *Thelymitra* (Forster & Forster 1776). A New Zealand collection of *T. longifolia* Forster made by the Forsters on Captain Cook's voyage of 1773 was used to establish the genus (Johns & Molloy 1983). Similarly, Smith (1798) named the genus *Diuris* from specimens of *D. aurea* Sm. collected at Sydney. The occurrence of *Thelymitra* and *Diuris* in Western Australia were to be brought to the attention of the scientific world shortly by the first major taxonomist to treat Australian orchids, Robert Brown.

The expedition to circumnavigate Australia led by Matthew Flinders in the *Investigator* anchored at King George Sound on 8 December 1801. On board as naturalist was a young Scot, Robert Brown, appointed under the patronage of Sir Joseph Banks. Also in the party were the gardener Peter Good, as conservator, and the artist Ferdinand Bauer. A full month (to 5 January 1802) was spent in the Sound, affording Brown, Good and others ample opportunity to explore and collect plants from a range of habitats around Albany. Between 10 and 18 January, the expedition also explored and collected near Esperance, landing at Lucky Bay (in the present-day Cape Le Grand National Park) for five days, and on islands in the Recherche Archipelago.

Brown and his colleagues were late in the orchid season, but collected 13 species of south-western orchids, all subsequently named by Brown (1810). Their thoroughness was reflected in the fact that only an additional four species have since been found flowering in December in the vicinity of Albany (Heberle undated). None of the 13 species collected in 1802 is in *Caladenia*, *Drakaea* Lindl. or allied genera. Undoubtedly, this would have been different had the expedition landed in spring rather than early summer.

Brown's contribution to the systematics of Western Australian orchids was far more substantial than making and describing collections of his own and colleagues. In addition, in his pioneering "Prodromus Florae Novae Hollandiae et Insulae Van-Diemen" (Brown 1810), he established 12 of the genera now known in Western Australia—*Caladenia*, *Calochilus* R. Br., *Cryptostylis* R. Br., *Cyrtostylis*, *Epiblema* R. Br., *Eriochilus* R. Br., *Gastrodia*, *Genoplesium* R. Br., *Lyperanthus* R. Br., *Microtis*, *Prasophyllum* and *Pterostylis*. Brown also named *Caladenia* section *Leptoceras* R. Br. which was subsequently elevated to generic rank by Lindley (1830–1840), and *Caleana* R. Br., recently split with its segregate genus *Paracaleana* Blaxell occurring in the south-west (Blaxell 1972).

The three species mentioned in the opening paragraph of the present paper that were collected from King George Sound by Menzies were named by Brown (1810), including the first Western Australian *Caladenia* (*C. flava*). Several additional species named by Brown (1810) from material collected in south-eastern Australia have since been found in Western Australia, such as *Pyrorchis nigricans* (R. Br.) D.L. Jones & M.A. Clem., *Caladenia latifolia* R. Br., *Cyanicula caerulea* (R. Br.) Hopper & A.P. Br., and *C. deformis* (R. Br.) Hopper & A.P. Br.

Interestingly, French botanists before and immediately after Brown's visit failed to collect orchids from the south-west coastline, mainly because of the timing of their explorations. Botanist Jacques

Julien de la Billardiere, and doctor and botanist Charles Riche with D'Entrecasteaux's expedition collected plants near Esperance from 13–20 December 1792, including the first kangaroo paw which Labillardiere subsequently named *Anigozanthos rufus* Labill. On 15 December Riche became lost inland from Dempster Head, and the next day had to abandon the plant specimens he collected in his urgency to get back to the coast and his ship (Marchant 1982). Late-flowering orchids may have been among these, but there is no record to inform us.

And on the west coast, botanists Andre Michaud, Leschenault de La Tour, and Jacques Delisse, head gardener Anselme Riedle, and gardener's boys Antoine Guichenot and Antoine Sautier with the Baudin expeditions (May–September 1801; February–March 1803), and Quoy, Gaimard and C. Gaudichaud with the Freycinet expedition (1818) all similarly did not make orchid collections that survived to be studied by taxonomists.

The genus *Corybas* was first described by Salisbury (1807) on the basis of material of *C. aconitiflorus* Salisbury from Sydney. Another 66 years would elapse before the occurrence of this genus in Western Australia was recorded by Bentham (1873).

Another famous botanical explorer, Allan Cunningham, as a member of Phillip Parker King's Australian coastal survey expeditions, appears not to have included orchids among his collections made on Middle Island on January 16, 1818, and at King George Sound during 20–31 January, 1818 and from 24 December 1821 to 5 January 1822 (Curry & Maslin 1990). Again, his visits occurred well after the main peak of flowering for orchids.

Similarly, the horticultural collector William Baxter worked in the vicinity of King George's Sound, Lucky Bay and Cape Arid in the years 1823–1825, and in 1829 (Maiden 1909). Little is known of his activities, and no orchid specimens of his are known. In a letter from King George Sound dated March 25, 1829 to Sydney's Colonial Botanist Fraser, Baxter remarked "Specimens: I have not got any worth sending, this being the worst time in all the year for them, but if we remain here until the spring I will get a rare collection." Unfortunately, Baxter sailed to Sydney in July, and missed the spring with its flush of flowering orchids (Maiden 1909).

Thus, prior to the establishment of the Swan River Colony in 1829, only 16 species of orchids had been collected in the south-west, all from King George Sound, and the majority late-flowering. In addition, 17 genera and some additional eastern Australian species to be found later in the south-west had also been named, primarily by Robert Brown (1810).

Early colonial phase

The arrival of James Drummond (1784–1863) at the Swan River with Captain Stirling's colonizing party on the *Parmelia* in 1829 heralded a major advance in knowledge of the south-west's orchids (Erickson 1969). Drummond, a Scot and keen nurseryman, formerly Curator of the Botanical Gardens at Cork, Ireland, was designated as unpaid Government Naturalist for the Swan River Colony.

Drummond soon became occupied as the Colony's official gardener, and was paid as such for a year (1831–1832). Additionally, he established homes and farms for his family briefly at Guildford (November 1829), but then at Ascot (early 1830), at the foot of Mt Eliza (1831), at Helena Valley (1831), and finally the main farm *Hawthornden* at Toodyay (1836).

In these early years, the family came to know the plants and animals of the Perth area intimately. As Rica Erickson (1969) recounted:

“Their adopted land enchanted the Drummond family. Each member brought home new plants which they found in the bushland. At the time there were few books written on the flora of Australia. Those in their possession were pored over by Drummond as he sought to identify flowers, many of which had never been seen before. The boys were most successful collectors, as they spent much time in the bush and had many opportunities when they went hunting and shepherding, or searching for lost stock.

Plants were not their sole interest. They built up a large collection of insects, and they learned to skin birds and other animals for scientific collectors at Capetown. It is known that they sent at least two extensive collections to South Africa where such specimens and seeds of wildflowers found a ready sale with recognized agents there. The shelves in their home were always overflowing with specimens.”

A visitor to the Swan River Colony in 1831 was to initiate a chain of events of long-lasting significance to the collection and botanical description of the local flora, especially the orchids. Captain James Mangles, retired naval commander, arrived aboard the *Atwick* in April for a three month stay at the invitation of his cousin, Lady Stirling, the Governor's wife.

Mangles, of London, was noted for his authorship of “Travels in Egypt, Nubia, Syria and Asia Minor in 1817–18”, and was a man of sufficient wealth, interest in the sciences and public spirit to be a Fellow of the Royal Society, Fellow of the Royal Geographical Society, and active member of the Ornithological Society and Horticultural Society. With regard to plants, he promoted the growing of species from foreign countries in gardens throughout Britain.

Mangles met many of the Swan River colonists during his stay, and struck up a friendship with George Fletcher Moore, Commissioner of the Civil Court (Moore 1884). The occurrence of Mangles' visit in late autumn to early winter meant that he missed the main wildflower season. However, Moore gave Mangles “some specimens of flowering shrubs, besides a bottle full of snakes, lizards and scorpions” as a gift of Swan River collections. These, together with others taken back to England by Mangles, aroused considerable interest in the exotic flora of south-western Australia.

In the meantime, another distinguished patron of botany and noted traveller, Baron Karl A.A.F. von Huegel of Vienna, visited the Swan River Colony and King George Sound from 17 November 1833 to 12 January 1834. Huegel collected many specimens during his brief visit, which was described by Diels (1906) as follows:

“He investigated the islands at the entrance to the Swan River, collected on both banks in the neighbourhood of Perth, and penetrated towards the interior as far as the foot of the Darling Range, at Darlington. He remained on the Swan River until the 19 December, and then continued on by sea to King George Sound where he remained from 1–12 Jan. 1834. His excursions were made in the immediate vicinity of the Sound but also not far from Albany and then on to the King and Kalgan Rivers – naturally on the lower courses of these rivers.”

Three orchids were subsequently named from reputed Huegel collections – *Elythranthera brunonis* (Endl.) A.S. George (as *Glossodia brunonis*, by Endlicher 1839), *Thelymitra flexuosa* Endl. (Endlicher 1839) and *Caladenia huegelii* H.G. Reichb. (Reichenbach 1871). The type sheet of the latter species actually has three species on it - typical *C. huegelii* (as lectotypified by Hopper and M. Clements in Clements (1989), not by George (1971a)), *C. paludosa* Hopper & A.P. Br. and *C. ensata* Nicholls (not *C. longiclavata* E. Coleman var. *longiclavata* as stated by George 1971a). Only two of these five species (*E. brunonis* and *C. paludosa*) have been collected or recorded flowering as late as late November. Hence, it seems highly improbable that Huegel collected any of these orchids himself. It is likely, in fact, that the Drummond family may well have given dried specimens of some or all of these species to Huegel, given their enthusiasm recounted above for the local flora of the Swan River. Huegel and James Drummond knew each other well enough for Huegel to be included among the subscribers to Drummond's future collections of seeds in the early 1840s.

In July 1835, George Moore and Lady Stirling received letters from Captain Mangles seeking assistance in obtaining seeds and live plants from Western Australia. Moore was aware that James Drummond and his son Johnston, then resident in the Helena Valley, were collecting seeds of native plants for shipment and sale at Capetown. Moore purchased 100 packets of seeds from the Drummonds and shipped them immediately back to Mangles. Late in 1835 an enthusiastic reply was received requesting more material.

In the meantime, on September 18, James Drummond independently wrote to Mangles offering to collect seeds and specimens for payment. A sample of seeds of several species was included with Drummond's letter. Mangles forwarded the letter on to Dr John Lindley, Professor of Botany of London University, Secretary of the Horticultural Society, and renowned orchidologist, who wrote back to Mangles in December 1836 in favour of the idea:

"I think good Swan River specimens would sell for two pounds per 100 papers, that is the market price for such things. Probably a dozen purchasers at least would be found. But as it is not known how Drummond would prepare the specimens I recommend him to send 2 or 3 sets of 100 or 150 each upon trial. I will take one set. We horticultural people wish for ten pound worth of seeds and bulbs as a venture. Nothing but very handsome things will do, we would rather have a good deal of seed of a very few sorts than a little seed of a good many sorts. If the seed suit us, we may be very good customers."

Mangles responded immediately to Drummond's letter of September 1835 requesting, among other things, all kinds of orchids. Thus began Drummond's career as a major commercial collector of south-western flora, with an initial focus on orchids.

In 1836 he prepared a box of orchid tuberosids for shipment. They perished on the voyage to London, as he suspected they would, and insects consumed all the seeds sent as well. Undeterred, Drummond wrote again on 23 August 1836 offering his services as a collector:

"If you can procure me some orders to enable me to live in the bush I will send you specimens and seeds, mosses and insects etc. until you are tired of them"

It would be a year later in September 1837 before Drummond received letters of support from both Mangles and Lindley. At this stage, he was given no idea that Mangles was losing interest in his commercial collecting activity.

This was reflected by the fact that Mangles also wrote in December 1836 to colonists recommended by Lady Stirling who might collect seeds for sheer interest rather than as a source of income. Included among these were Mrs Georgiana Molloy of Augusta and Captain Richard Meares of Guildford, both of whom agreed to help.

Mrs Molloy, a keen gardener, and her young family took on the task with enthusiasm through the spring of 1837 (Hasluck 1955). Specimens were pressed and numbered as each species flowered, and plants watched thereafter (especially by daughters Sabina and Mary) for the fruits to ripen ready for collection of seed.

Tragically, her infant son John was drowned in November of that year. Overcoming this event, a subsequent sickness and pregnancy, together with the demands of running an isolated colonial household, delayed preparation for shipment of Mrs Molloy's meticulously pressed specimens for another year. The delay enabled additional specimens from the spring of 1838 to be added, including plants collected by Captain Molloy from The Vasse (Busselton). On November 16 of that year, Mrs Molloy shipped her specimens and seeds to Lady Stirling for subsequent shipment to Mangles in London.

In the meantime, James Drummond also spent the spring of 1837 collecting material for shipment to Mangles in November 1837 on the *Hero*. The box contained 'some hundreds of the most beautiful plants', including 'about 200 tubers of native orchids'. Mangles had also sent old newspapers, and this enabled Drummond to press and dry specimens of many plants collected on the Swan Coastal Plain, along the Toodyay Road and in the vicinity of Toodyay. Orchids were included in this collection.

Fulfilling this order led Drummond, on 18 October 1837, to finish writing the first account of the underground structures of Western Australian orchids. The paper was published in the *Gardener's Magazine, London*, the next year (Drummond 1838). This paper is remarkable in its modern appreciation of the biology and taxonomy of the orchids found in and near Perth.

For example, Drummond accurately described and depicted the fibrous multilayered tunica that ensheaths the tuberoids of species of *Cyanicula* Hopper & A.P. Br. and *Elythranthera* A.S. George. Furthermore, he was of the view that such species "belong to two genera", that were quite distinct from *Caladenia*. In this paper, he also made clear the differences in leaf morphology between *Drakaea livida* J. Drumm. and *D. elastica* Lindl., and described as separate species *Caladenia longicauda* Lindley and *C. huegelii* in unmistakable terms:

"The large species I send you ... has sometimes a flower 11 in. from tip to tip of the petals; and another species, with a yellow flower and dark purple lower lip, grows nearly as large, and is a very beautiful plant."

Drummond had a disagreement with Lady Stirling about to whom had been intended boxes of plants and trees sent by Mangles aboard the *Hero*. This disagreement was conveyed to Mangles by Lady Stirling, and may have led to further consideration by Mangles' to cease facilitating Drummond's collecting activities.

However, on receiving Drummond's first collection of dried specimens on the return ship early in 1838, Mangles handed them on to Dr Lindley, who was delighted to find many new species and genera among them. Lindley prepared descriptions of some of these for publication. The collection affirmed Drummond's importance as a collector among English botanists.

In September 1838, George Fletcher Moore was advised in a letter from Mangles that the latter wished to terminate his seed orders. Drummond was not so advised until after the departure for England of the *Joshua Carroll* on 8 December 1838. On board was a major consignment of seeds, live plants and dried specimens, consigned by Drummond at his own cost to Mangles. Also, Lady Stirling forwarded Georgiana Molloy's collections on the same boat.

Drummond, perplexed by the change of interest of Mangles, was powerless to recall or redirect his shipment. After arriving at Mangles' door early in 1839, it ended up in the hands of Dr Lindley, who secured the volunteer services of a young George Bentham to divide the collection up and distribute it.

Lindley was pleased to receive the new material from Drummond and Mrs Molloy, as he had yet to finalise his manuscript describing plants from the Swan River Colony, and several more new taxa were among those presented to him. Drummond was not to know the fate of these specimens for some time yet.

Meanwhile, in a letter dated 28 May 1839 to Hooker, Drummond indicated that he had decided to make another substantial collection (ten sets of 1000 species) the coming spring, in the hope that subscribers could be found. He indicated in the letter that he had already gathered some 60 species of Orchidaceae, and that "a zealous young German botanist – a Mr Preiss, had lately arrived here".

Johann August Ludwig Preiss (1811–1883), was the only notable European collector of orchids in the early colonial phase. His south-western Australian specimens were labelled with locality information and the date of collection, enabling some of his movements to be traced with considerable accuracy (Marchant 1990). Preiss's orchid collections were written up by Endlicher (1846) in a multi-authored two-volume work "Plantae Preissianae" edited by Professor Lehmann of Hamburg. By the time this work was published, most of the species collected by Preiss had already been described by Lindley (1840) from Drummond's collections.

The earliest orchid collection of Preiss cited in this work is of *Caladenia unguiculata* [= *Cyanicula deformis*] obtained on 19 January 1839 from woodland near the Limekiln (vicinity of Subiaco), Perth. Preiss subsequently made orchid collections in June at Lake Monger, July at the Canning River, Guildford and Darling Scarp cataraacts on Susannah Brook, and August on Rottnest Island before venturing eastwards to York in late August to early September. On returning to Perth, on 23 September 1839, Preiss collected the type of *Elythranchera brunonis* in woodland on sand. He made a few more orchid collections near to Perth in the ensuing months before venturing to Albany, where his first orchid collection was of *Cryptostylis ovata* from Strawberry Hill on 9 January 1840.

Later in 1840, Preiss collected orchids from Albany and the granite inselberg Willyung nearby to the north. The most important of these specimens was the type of *Caladenia nana*, collected from Mt Clarence on 5 October 1840. Back in Perth in 1841, Preiss made a couple of orchid collections from the Darling Range, including a small variant of *Caladenia longicauda* Lindley which Endlicher recognized as forma *humilior* (possibly *C. longicauda* subsp. *clivicola* Hopper & A.P.Br.). This was an important early insight from a European taxonomist that there was actually infraspecific variation in a species of south-west Australian orchid which many subsequent authors would subsume in unworkably broad concepts of polymorphic Australian orchid species.

In June 1839, Drummond wrote a long letter describing the plants to be seen between Fremantle and Perth. The letter was published in 1840 in Hooker's Journal. Drummond indicated that between

the Swan River and the top of the Darling Range, he had collected 30 species of Orchidaceae. He described a selection, including what were subsequently named as *Epiblema grandiflora* R. Br., *Paracaleana nigrita* (J. Drumm. ex Lindl.) Blaxall, *Drakaea livida* J. Drumm., *D. elastica* Lindl., and *Spiculaea ciliata* Lindl.

Subsequently, from his farm at Toodyay on 14 October 1839, Drummond penned another letter to Hooker detailing discoveries made during his busiest spring yet. After describing plants encountered on a visit to Rottnest Island in company with the botanist Preiss, the bird-collector John Gilbert, and a Dr Walker, Drummond recounted observations of orchids seen between Perth and Toodyay. Firstly, he wrote of *Cyanicula* Hopper & A.P. Br:

“A pretty Orchis which I cannot refer to any of Mr Brown’s genera is now in blossom by the roadside; it is remarkable for producing varieties of blue, yellow and white flowers. I am acquainted with two other species of the same genus, with blue flowers varying to white, but this is the only instance I can recollect of a blue flower changing into a yellow; the yellow kind is very rare to the west of the Darling Range of hills where the blue is common; but in the Toodyay district some of the hills produce the yellow plant in thousands without any mixture of blue; still I am satisfied they are the same species.”

Drummond was here describing the blue *C. gemmata* (Lindl.) Hopper & A.P. Br. and the yellow *C. ixioides* (Lindl.) Hopper & A.P. Br., which we consider to be distinct species. The other two cyaniculas he alluded to were undoubtedly *C. deformis* (R. Br.) Hopper & A.P. Br. and *C. sericea* (Lindl.) Hopper & A.P. Br., both common in the country by then well known to him. He continued:

“My family have paid a good deal of attention to the Orchideae and we have gathered between 60 and 70 species; the few botanical books I brought out with me having been soon lost by a fire, we consequently know nothing of the names of even the genera, but every Orchis we found for the first time was new to us and were distinguished among the different members of the family, by the finders name, such as Jane’s yellow spiral leaved, John’s spotted spiral leaved, etc. etc.

My youngest daughter, Euphemia, knows the Swan River Orchideae quite as well as I do myself and she is able to tell any of her brothers who pick up an Orchis, whether there is any chance of its being what we call a new one or not. Some of the genera, for we found it necessary to make genera to help in distinguishing the different species, turned out to be exactly the same as Mr Brown’s.”

Drummond then went on to describe how rare some of the orchids were, and detailed three species of interest seen for the first time that season – *Caladenia falcata* (Nicholls) M.A. Clem. & Hopper, a greenhood he named *Pterostylis rupestris* J. Drumm., and *Caladenia barbarossa* H.G. Reichb. Of the latter, Drummond remarked:

“A third Orchis, also detected this season, forms a different genus from any we had seen before; its lower lip resembles an insect and assumes the appearance of a head and feet, which none of the other insect-like Orchideae have.”

Thus, Drummond and his family had acquired an impressive understanding of the orchids between Fremantle and Toodyay, recognizing 60–70 species, and distinguishing what we have named

Cyanicula and *Caladenia* subg. *Drakonorchis* Hopper & A.P. Br. (Hopper & Brown 2000) as distinct genera from *Caladenia*. By the end of the 1839 spring, however, Drummond had ceased corresponding with Mangles, and was to lose interest in making further substantial collections of orchids.

Understandably, there must have been a mixture of pleasure and consternation when Drummond finally received a copy of Lindley's "A Sketch of the Vegetation of the Swan River Colony", which was published early in 1840 and drew heavily on Drummond's letters and his paper on the underground structures of Swan River orchids.

Lindley, working with dried specimens and without the insights of seeing living plants, described some 50 species, not 60–70. He also did not recognize *Cyanicula* and *Caladenia* subg. *Drakonorchis* as genera distinct from *Caladenia*. He did, however, recognize most of what Drummond sent him as distinct, and this must have pleased Drummond.

Nevertheless, in a letter to Hooker dated 13 April 1842, Drummond expressed concern at how Lindley had lumped species of kangaroo paw (*Anigozanthos*) and *Drakea* Lindley that to him were perfectly distinct and good species when seen as living plants (see opening quotation). In the same letter he described a specimen of *Calochilus* R. Br. found near Toodyay, "the only individual I have ever found of a most curious orchideous plant".

Drummond's waning interest in orchids was evident, but he did make one further interesting discovery in the spring of 1844 while travelling north of Toodyay to the vicinity of Lake Moore. In a brief sentence, he unmistakably describes his discovery of *Caladenia drakeoides* Hopper & A.P. Br.

"Near our first bivouac I gathered a singular Orchidaceous plant having the hinged lower lip of *Drakea* but with other characters which will probably refer it to the same genus with 861 of my large collection: only three plants could be detected in flower and one of them I put into spirits as you directed. Our present mode of travelling is not favourable for collecting Orchidaceae which require close investigation of particular spots in order to detect them ..."

Drummond's collection number 861 is the type specimen of *Caladenia barbarossa* H.G. Reichb., gathered near Toodyay in 1839.

Taxonomic concepts

Our taxonomic concepts are described below. Few authors have provided such information in previous publications dealing with Australian orchids. Fitzgerald (1888) was a notable exception (see his discussion of *Caladenia dilatata* and *C. patersonii*). More recently, Clements (1989) provided a brief account of his concepts of taxonomic rank.

An explicit statement of concepts is essential for the scientific evaluation of a taxonomic work. Without it, future readers are unable to understand accurately the hypotheses underlying the names provided, and critical testing of such hypotheses is rendered difficult. While we accept that an element of subjectivity is part of all scientific inquiry, the best works in the field are those that present ideas and data in a way that ensures that they can be examined critically and tested by other workers.

Species and subspecies

New species are recognized if they grow in populations (i.e. are not aberrant individuals within normal populations), if they have features or a combination of features not seen in any previously named species, and especially if they grow with previously named species and produce few or no natural hybrids. Differences in flowering times, in habitats occupied, and in pollinators are other attributes we have used to help identify new species in some cases. Geographical races with minor morphological differences are recognized as subspecies. These may hybridize and intergrade extensively where their geographical ranges overlap. Our species and subspecies concepts are thus both morphological and biological, springing from the approaches lucidly summarised by Grant (1981).

It is important to note that our consideration of biological as well as morphological data in deciding on species rank is a fundamental difference to the approach of George (1971a) and his predecessors. It leads to the recognition of more species. In allocating species rank, George took little account of breeding barriers between coexisting taxa. For example, many combinations of the five varieties of *Caladenia filamentosa* R. Br. recognized by George (1971a) grow together without hybridizing, but he judged them to be only worthy of varietal rank. In contrast, because of their predominant failure to interbreed when sympatric, we recognize these five taxa and a number of others previously undescribed as species.

Hence, our approach in some cases leads to a morphologically narrower species concept than those advocated by George (1971a) and others. However, we have ensured that all taxa recognized as species have reliable diagnostic morphological characters. To take the *Caladenia filamentosa* complex as an example, George's broad concept of the species in Western Australia emphasised as diagnostic features the long filiform non-clavate petals and sepals, the calli in two rows, and the short marginal teeth on the labellum. To identify species of the *C. filamentosa* complex in our treatment, users are required to look closer and examine attributes such as the shape, size, three dimensional structure and colour of flower parts and leaves. We have found that many local orchid enthusiasts become adept at recognising such distinctions once they have been pointed out. Hence, we are encouraged that our narrower species concepts are nevertheless workable.

We believe that they have the additional advantage of more closely reflecting biological reality than do the broad concepts of "polymorphic" species of past authors. There are many practical advantages arising from our treatment, not the least being improved management for conservation and cultivation, and more precise communication and conduct of popular and scientific studies of south-western orchids.

For example, a broad concept of *Caladenia filamentosa* includes populations of diverse ecological tolerances and phenologies, from winter flowering plants on remote granite outcrops well inland in the arid pastoral region, to early summer flowering plants in the highest rainfall country on consolidated dunes of the south coast. Knowing that *C. filamentosa sens. lat.* is on a conservation reserve provides little practical help to a manager concerned about fire regimes, for instance, because the literature would indicate that the flowering season could be any time over a six month period, and the habitat occupied could be anything from well-drained soils on the highest eminences, to seasonally-waterlogged flats low in the landscape. Similarly, the appropriate watering regime for cultivated plants is difficult to predict if all the grower knows is that specimens are of *C. filamentosa* in the broad sense. Both the conservation manager and the grower are forced to find out for themselves exactly what are the biological attributes of the particular plants of *C. filamentosa* that they are looking after (often to the detriment of the orchids if initial guesses about fire or watering regimes are wrong).

The poor predicability of such a broad species concept contrasts with that in our treatment of the *Caladenia filamentosa* complex. Land managers or orchid growers will know, for example, if they have plants of *C. abbreviata* Hopper & A.P. Br., that they are late-flowering denizens of south-coastal dune country requiring good soil moisture conditions. *C. remota* Hopper & A.P. Br. is a winter/spring flowering inhabitant of inland arid zone granite rocks subjected to prolonged periods of dry soil. *C. dimidia* Hopper & A.P. Br. occurs in the wheatbelt on good soils, etc.

To highlight another significant implication of the species concept adopted, a broad view of *Caladenia filamentosa* gives no suggestion of conservation problems, because members of the complex range all across southern Australia, and some are abundant in conservation reserves. Even if rare infraspecific taxa are recognized such as George's (1971a) concept of *C. filamentosa* var. *dorrienii* (Domin) A.S. George, they will not feature in the national list of rare and threatened plants (Leigh & Briggs 1996) because it includes only species.

In contrast, our treatment segregates out from the *Caladenia filamentosa* R. Br. complex several common well-reserved species but also a few that are rare, such as *C. dorrienii* Domin and *C. elegans* Hopper & A.P. Br. (Hopper *et al.* 1990; Brown *et al.* 1998). If our concepts are followed, these threatened plants will receive the attention they deserve from authors such as Green (1985) and Leigh & Briggs (1996) who ignore infraspecific taxa.

Of course, we do not advocate the elevation of all infraspecific taxa to specific rank for this reason. Such an approach leads to unacceptably narrow species and an often unworkable taxonomy (see below). But where taxa meet our biological criteria regarding strong reproductive isolation in sympatry, and are morphologically distinct, species rank is considered most appropriate.

Perhaps the legacy of greatest concern regarding past concepts of polymorphic Australian orchid species is the diminished value of much of the information in the popular and scientific literature. Almost without exception, previous authors, despite making meticulous observations over considerable periods, have used names like *Caladenia filamentosa* or *C. patersonii* without citing voucher specimens nor even giving precise locations from where their material came.

This serious oversight recurs in popular books and field guides (e.g. Pelloe 1930; Blackall & Grieve 1954; Erickson 1965; Nicholls 1969; George & Foote (undated); Cady & Rotherham 1970; Clyne 1970; Pocock 1972; Hoffman & Brown 1984; Woolcock & Woolcock 1984; Jones 1988; Bennett 1988; Bates & Weber 1990). Perhaps even more unexpectedly, voucher specimens are rarely cited in scientific studies of south-western orchids dealing with mycorrhizal fungi (Warcup 1971; Ramsay *et al.* 1986), pollinators (Sargent 1907; Stoutamire 1974, 1975, 1981, 1983; Bates 1979; Peakall 1984, 1988, 1989; Peakall & James 1989b), chromosome numbers (Peakall & James 1989a), or hybrids (Hopper 1973, 1979; Heberle 1982).

Without voucher specimens, it is often difficult or impossible to relate much valuable and expensively-acquired data to the species segregated out from species complexes by previous taxonomists or ourselves. Conflicting results obtained by researchers working on the same topic may be due to the fact that they are working on different species within a complex. One only has to read the various attempts of authors to describe broadly-conceived species such as *Caladenia filamentosa sens. lat.* to appreciate this problem.

In many ways, the development of concepts regarding these orchid species complexes parallel that described by Hillis *et al.* (1983) for the American Leopard Frogs (the *Rana pipiens* complex). These

animals were the standard tool for generations of zoological physiologists. Numerous scientific papers were written about these animals, often with conflicting results and acrimonious assertions. Although 12 species had been described in the complex from conventional morphological studies by 1900, the number was reduced to four as the polytypic species concept rose to ascendancy among vertebrate zoologists in the 1940s and 1950s. However, intensive field work in the 1960s and 1970s established that there were, in fact, many taxa that occurred in sympatry with little or no hybridisation. These taxa had distinctive morphological, auditory, biochemical and reproductive attributes, leading to the realisation that there were indeed numerous distinct species of leopard frogs (23 are now recognized). Much of the conflicting results of earlier work was accountable by opposing researchers using different species for their experiments, but reporting that they were using the same (polytypic) species.

The situations detailed above for species concepts in the *Caladenia filamentosa* R. Br. complex could be repeated for several other complexes in south-western Australia. As with the final resolution of the leopard frog complex, we consider that our taxonomic concepts for these orchids have significant practical implications that will considerably advance the cultivation, conservation and study of the plants involved.

Because of the past use of varieties for many taxa now recognized as species, we have avoided using the rank of variety for infraspecific taxa, and instead use subspecies as the appropriate category. Interestingly, Clements (1989) and Jones (1991, 1998) recognized very few infraspecific taxa in their treatments of Australian orchids, favouring species as the preferred lowest rank. This approach is too constraining in our view, and may create unnecessary problems for users of their taxonomy by advocating very narrow species concepts in some cases.

For example, Clements (1989) regarded *Caladenia longicauda* Lindl. and *C. eminens* (Domin) M. Clem. & D.L. Jones as distinct species. Our studies show that these taxa are very similar morphologically, and intergrade where their ranges overlap. In many populations, we have not been sure if they comprise *C. longicauda* or *C. eminens* or both, even with fresh flowers in the hand. In other populations removed from the zone of overlap, the taxa can be recognized with greater certainty. It seems more appropriate, in such circumstances, to regard these taxa as subspecies rather than as species. Similar considerations underlie our conviction that *C. nana* Endl. and *C. unita* R. Fitzg. are best treated as subspecies rather than species as advocated by Clements (1989).

Further resolution of species in Australian orchids is just emerging from genetic studies using allozyme and DNA markers. For example, Carstairs & Coates (1994) examined allozyme variation among populations within rare south-western taxa of *Caladenia*, *Drakaea*, *Diuris* and *Rhizanthella*. Recognized species behaved as expected in these genetic analyses. Carstairs (pers comm.) examined relationships within selected south-western *Caladenia* using allozyme markers, and established the genetic distinctness of groups represented by *C. hirta* Lindl., *C. falcata* (Nicholls) M.A. Clem. & Hopper, *C. longicauda* and *C. caesarea* (Domin) M.A. Clem. & Hopper. He also established that some closely-related species recognized by us, such as *C. caesarea* and *C. luteola* Hopper & A.P. Br., were genetically distinct.

More recently, Kores *et al.* (2000) have examined DNA sequence data, especially for the *Caladenia* alliance, and have obtained some additional evidence of species relationships (cf. Hopper & Brown 2000). Further work is needed in this exciting field to test hypotheses of species boundaries erected in this series of papers.

Hybrids

Some south-western orchid hybrids are spectacular, readily identified and often encountered. Others are rare, and warrant special protection. Many found by orchid enthusiasts cause considerable identification problems because, hitherto, they have largely been ignored in published works on Western Australian orchids (other than by Hopper 1979; Heberle 1982).

For these reasons, hybrids are recognized and named formally by us if they occur as sporadic individuals among mixed populations of likely parental taxa, and where their flowers are clearly intermediate between those of their presumed parents. The presence of an "x" preceding a species' name denotes its presumed hybrid status.

We have not formally named hybrids where their identification is rendered difficult by the presence of backcrosses in many populations, so that a complete transition in form occurs from one species to the other. In such situations, reference to hybrids is preferred by the conventional formula of the names of the parental taxa linked by an "x".

Genera

Since the early 1980s, we have been examining generic relationships in Australian orchids. Initially, new genera were recognized on the basis of detailed numerical taxonomic studies of Australasian and South American terrestrial genera (Hopper, unpubl. ms). This work established the presence of some segregate genera within *Caladenia sens lat.*, and also identified the generic distinctness of what is now known as *Pyrorchis* D.L. Jones & M.A. Clements from typical *Lyperanthus*.

We informally published our conclusions on generic matters in colour field guides to enable wide scrutiny of our concepts before formal publication (Hoffman & Brown 1992, 1998). We argued for a reduced circumscription of *Caladenia*, with the reinstatement of *Leptoceras* (R. Br.) Lindley and the erection of three new genera, *Cyanicula*, *Praecoxanthus* Hopper & A.P. Br. and *Drakonorchis*. We also proposed that *Lyperanthus nigricans* R. Br. and *L. forrestii* F. Muell. be transferred to the genus *Burnettia* Lindl., but subsequently (in ms.) proposed to erect a new genus. This latter conclusion was supported and overtaken by Jones & Clements' (1994) description of *Pyrorchis*.

Recent DNA sequence studies of the Orchidaceae, including the Diurideae and the *Caladenia* alliance in particular (Kores *et al.* 2000, 2001), have affirmed our proposals except for *Drakonorchis* which appears to be deeply embedded within *Caladenia* (Figure 2). Elsewhere (Hopper & Brown 2000) we formally described *Cyanicula* and *Praecoxanthus*, and presented a new subgeneric classification of *Caladenia* R. Br. in which five subgenera were recognized, three previously regarded as sections of the genus by Bentham (1873) and two newly named as *C. subg. Drakonorchis* Hopper & A.P. Br. and *C. subg. Elevatae* Hopper & A.P. Br. A key to all genera currently recognized in south-western Australia is given below.

Key to genera of south-west Australian orchidaceae

1. Subterranean herbs, saprophytic. Inflorescence a many-flowered capitulum **Rhizanthella**
- 1: Terrestrial herbs with leaves and flowers above ground, rarely saprophytic.
Inflorescence a raceme

- 2. Plant with rhizomes. Flowers bell-shaped **Gastrodia**
- 2: Plant with root-stem tuberoids. Flowers not bell-shaped
- 3. Leaves perennial, arising from tuberoid adjacent to flowering scape; petiole 2–10 cm long **Cryptostylis**
- 3: Leaves replaced annually, subtending the scape; petiole absent (except *Eriochilus*)
- 4. Column usually longer than 5 mm tall, lacking free staminodia; viscidium absent or reduced
- 5. Petals and dorsal sepal united to form a hood enclosing column. Auricles on column wings abutting in front of anther. Stigma more than twice length of anther **Pterostylis**
- 5: Petals and dorsal sepal free. Auricles (if present) on column wings not abutting. Stigma c. same length as anther
- 6. Labellum claw c. same length as lamina, closely appressed to column. Pollinia divaricated, almost contracted into caudicles **Eriochilus**
- 6: Labellum claw usually much shorter than lamina, if same length then not closely appressed to column. Pollinia simple, not contracted
- 7. Leaves solitary, hirsute, usually linear
- 8. Tuberoids encased in a multilayered tunica; hairs lacking enlarged basal cell; flowers usually blue, purple or pink
- 9. Upper surface of petals and sepals glossy. Calli 2, enlarged, basal **Elythranthera**
- 9: Upper surface of petals and sepals dull. Calli numerous along lamina
- 10. Petals and sepals blue (rarely yellow or white). Calli numerous, gradually decreasing in size from the base of the lamina apically **Cyanicula**
- 10: Petals and sepals pinkish purple. Calli in c. 12 pairs, the basal pair thickly cylindrical and much larger than the rest **X Cyanthera**
- 8: Tuberoids partially encased in a few layered tunica; hairs with an enlarged basal cell; flowers usually other than above (sometimes pink) .. **Caladenia**
- 7: Leaves solitary to several, glabrous, usually ovate to oblong
- 11. Labellum insectiform; claw c. same length as lamina
- 12. Scares wiry, with 1(2) flowers (except *P. lyonsii* 2–10 flowers)
- 13. Labellum claw hinged and passively mobile. Column curving upwards and with narrow auricular wings not pouched **Drakaea**
- 13: Labellum claw not hinged, actively sprung on touch. Column obliquely descending and with much-enlarged wings forming a pouch **Paracaleana**
- 12: Scares fleshy, with 4 or more flowers **Spiculaea**
- 11: Labellum not insectiform, claw much shorter than lamina
- 14. Petals erect, clavate, usually glandular
- 15. Leaves green with red stripes. Labellum transversely oval, lacking calli, margins fimbriate **Leporella**
- 15: Leaves green. Labellum trilobed, calli numerous, margins entire **Leptoceras**
- 14: Petals horizontal to downcurved, not clavate nor glandular

- 16. Dorsal sepal hooded over column
- 17. Flowers sessile, solitary **Corybas**
- 17: Flowers borne on a scape, few to many
- 18. Leaf fleshy, ovate. Labellum lamina with prominent fleshy longitudinal ridges and sparse small hemispherical calli **Pyrorchis**
- 18: Leaf thin, linear. Labellum lamina lacking ridges and calli densely clustered, incudiform, pyramidal, cylindrical to irregularly oblong and serrate on top or hemispherical **Lyperanthus**
- 16: Dorsal sepal held erect splaying away from column
- 19. Scape subtended by a fully developed basal leaf, many-flowered. Labellum glabrous **Cyrtostylis**
- 19: Scape subtended by a reduced bract-like basal leaf, 1-flowered. Labellum with calli **Praecoxanthus**
- 4: Column absent or shorter than 5 mm, with prominent free or united (mitral) staminodia; viscidium present
- 20. Leaves terete or tubular
- 21. Labellum on lower side of flower, below dorsal sepal **Microtis**
- 21: Labellum on upper side of flower, above dorsal sepal
- 22. Leaf well developed beyond point of departure from scape. Labellum immobile. Column with no basal foot. Anther held vertically and attached dorsally at the base, with a poorly developed rostrum **Prasophyllum**
- 22: Leaf reduced and bract-like beyond point of departure from scape. Labellum highly mobile. Column with a prominent curved basal foot. Anther held obliquely erect or horizontal and attached dorsally at the apex, with a strongly developed rostrum **Genoplesium**
- 20: Leaves channelled, distichous or flat
- 23. Leaves 2 to many. Labellum prominently trilobed. Anther and stigma sessile on ovary roof; staminodia free, not cucullate **Diuris**
- 23: Leaf solitary. Labellum not prominently trilobed. Anther and stigma on a short column; staminodia united into a cucullate mitra or free
- 24. Labellum petal-like, lacking appendages **Thelymitra**
- 24: Labellum clawed, with basal calli or densely hirsute
- 25. Labellum same size as petals and sepals, glabrous except for basal calli **Epiblema**
- 25: Labellum longer than petals and sepals, densely hirsute **Calochilus**

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**Contributions to Western Australian Orchidology:
2. New taxa and circumscriptions in *Caladenia*
(Spider, Fairy and Dragon Orchids of Western Australia)**

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Abstract

Hopper, S.D. & Brown, A.P. Contributions to Western Australian Orchidology: 2. New taxa and circumscriptions in *Caladenia*. *Nuytsia* 14(1): 27–xx (2001). Some 260 species of *Caladenia* R. Br. will be recognized Australia-wide following this taxonomic treatment of Western Australia's largest genus of orchids. A new key to the 112 Western Australian species is provided, as well as updated descriptions of all taxa needing attention as a consequence of our revisionary studies. Most taxa recognized herein are newly named, including 69 species and 26 subspecies. In addition, 15 new hybrids are recognized. There are also two new combinations, *Caladenia nana* Endl. subsp. *unita* (Fitz.) Hopper & A.P. Br. and *C. longicauda* Lindl. subsp. *eminens* (Domin) Hopper & A.P. Br. Currently 15 taxa are declared as Rare Flora and 21 have a conservation priority.

Introduction

Caladenia is Australia's largest and most complex genus of Orchidaceae and, as such, current research is progressing on several fronts to improve taxonomic knowledge of the group. The questions of generic boundaries in the *Caladenia* alliance and of major subgeneric groupings within *Caladenia* are being tackled through DNA sequence studies (Kores *et al.*, in preparation; Hopper & Brown 2000). Work at the species level is actively proceeding in eastern Australia, largely led by D.L. Jones and colleagues (Jones 1991, 1994, 1996, 1998, 1999), while we have undertaken complementary studies in Western Australia over the past two decades. At present about 260 species of *Caladenia* are recognized, including 69 new species described herein. In addition 26 new subspecies and 15 new hybrid combinations are formally described.

In Western Australia, 112 species of *Caladenia* are now recognized, including 107 endemics, all occurring in the south-west and forming by far the largest group of orchids in the State. Since the early 1980s, we have established the presence of some segregate genera within *Caladenia sens lat.*, and we informally published our conclusions on this matter in colour field guides (Hoffman & Brown 1992,

1998) to enable wide scrutiny of our concepts before formal publication. In summary, we had argued for the reinstatement of *Leptoceras* (R. Br.) Lindl. and the erection of three new genera.

Two of the proposed new genera, *Cyanicula* Hopper & A.P. Br. and *Praecoxanthus* Hopper & A.P. Br., were formally described (Hopper & Brown 2000), after support for them was obtained from recent DNA sequence studies of the Orchidaceae and the Diurideae in particular (Figure 1). The molecular data also supported the reinstatement of *Leptoceras*. However, the third proposed new genus, *Drakonorchis*, appeared from this molecular research to be deeply embedded as a distinct group (now regarded as a subgenus) within *Caladenia sens. lat.*

By excluding *Leptoceras*, *Cyanicula* and *Praecoxanthus*, we consider *Caladenia* to be much more clearly circumscribed than has been the case in the past. At the same time as we reduced the circumscription of *Caladenia* we formalized a new subgeneric classification for the genus, elevating three of Benthams' (1873) sections to subgenera (*Caladenia*, *Phlebochilus* [as *Phlebochila*] and *Calonema*), and describing two new subgenera, *Drakonorchis* and *Elevatae* [as *Elevata*] (Hopper & Brown 2000). The remaining two sections of *Caladenia* recognized by Benthams (1873) are now removed from the genus, with section *Leptoceras* Benth. now recognized as two separate genera (*Leporella* A.S. George and *Leptoceras*), and section *Pentisia* Benth. constituting the new genus *Cyanicula* (with the addition of *C. caerulea* (R. Br.) Hopper & A.P. Br. and *C. deformis* (R. Br.) Hopper & A.P. Br.), which Benthams placed in the typical section).

As well as including part of *Cyanicula*, Benthams included the *Caladenia flava* group (now *Caladenia* subg. *Elevatae*) and *Praecoxanthus* in his concept of sect. *Caladenia* [as *Eucaladenia*]. These are now regarded as quite distinct evolutionary groups. Some change is also needed for Benthams' circumscription of his sections *Calonema* (typified by *Caladenia longicauda* and including all the spider orchids, i.e. taxa with elongate petals and sepals) and *Phlebochilus* (typified by *Caladenia cairnsiana* and including the group of wasp-pollinated species with short petals and sepals). Of major interest, based on DNA sequence data (Figure 1), is that the wispy spider orchids of the *Caladenia filamentosa* complex are actually more closely related to species in *Caladenia* subg. *Phlebochilus* than to the other spider orchids (e.g. the *Caladenia patersonii* complex) which belong to *Caladenia* subg. *Calonema*.

Methods

Our taxonomic concepts and methodology are described in the accompanying paper (Hopper & Brown 2001). Conservation codes are cited in the notes under all taxa that are currently included on the Department of Conservation and Land Management's Declared Rare and Priority Flora List. An explanation of these codes is set out at the end of this *Nuytsia* issue.

Common names used in the habitat data throughout the paper apply to the following species: Christmas Tree (*Nuytsia floribunda*), Flooded Gum (*Eucalyptus rudis*), Jam (*Acacia acuminata*), Jarrah (*Eucalyptus marginata*), Karri (*Eucalyptus diversicolor*), Marri (*Corymbia caloplylla*),

Caladeniinae tree based on ITS

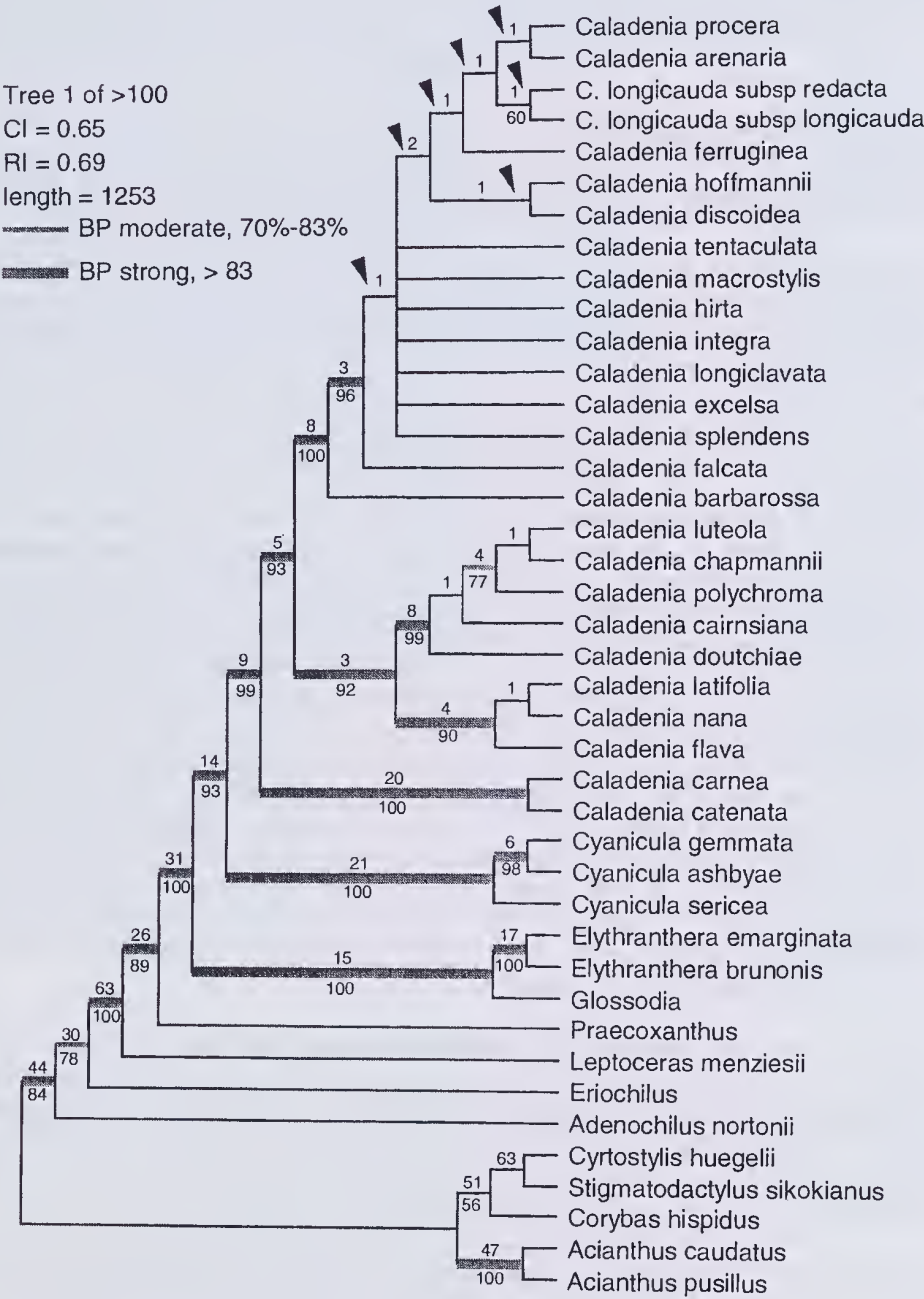


Figure 1. Evolutionary relationships of the *Caladenia* alliance, based on DNA sequence data of the ITS gene (Kores *et al.*, in prep.). Numbers at nodes are bootstrap values, with 100 meaning 100% confirmation of the node over 100 replicates.

Peppermint (*Agonis flexuosa*), Rock Oak (*Allocasuarina huegeliana*), Swamp Yate (*Eucalyptus occidentalis*), Tuart (*Eucalyptus gomphocephala*), Yate (*Eucalyptus cornuta*), York Gum (*Eucalyptus loxophleba*) and Wandoo (*Eucalyptus wandoo*).

Generic description

Caladenia R. Br., Prod. 323 (1810).

Type: Caladenia carnea R.Br., lectotype, *fide* M. Clements, *Austral. Orchid Res.* 1: 20 (1989).

Perennial terrestrial *herbs*, with rounded white tuberoids partially enclosed in a shaggy fibrous sheath which is persistent on their upper half and extends upwards where it ensheathes the narrow stem to ground level. *Leaf* solitary, usually erect to semi-erect (rarely reclining), linear to broadly linear or lanceolate, pale yellowish green to dark green, base usually irregularly blotched with red-purple, sparsely to densely hirsute with patent eglandular (rarely glandular) trichomes to 4 mm long with an expanded barrel-shaped basal cell. *Scape* erect, wiry, hirsute with simple or rarely glandular patent trichomes similar to those on the leaf, with an erect sheathing acuminate externally hirsute cauline bract half way up and a similarly shaped floral bract under each pedicel. *Inflorescence* erect, solitary, 1-flowered or with up to 8 flowers in a loose raceme or panicle. *Flowers* sometimes scented, variously coloured, on finely hirsute pedicels 1–4 cm long. *Ovary* erect, linear-obovoid, densely covered with fine glandular patent trichomes. *Sepals and petals* (excluding labellum) short- to long-acuminate, usually with short glandular hairs on the abaxial surface and on the long-acuminate apex where present, the latter sometimes expanded into a thickened glandular osmophore. *Dorsal sepal* usually erect and narrow, incurved over the column or more rarely retracted. *Lateral sepals* usually spreading (rarely reflexed against the ovary or falcate with upturned apices), usually broader than the dorsal sepal and petals. *Petals* usually spreading (rarely erect or reflexed against the ovary), narrow. *Labellum* usually glabrous, stiffly hinged but readily pushed away from column and springing back to original position on release (sometimes loosely hinged), undivided or 3-lobed with erect lateral lobes, usually recurved at the apex, often laterally fringed or toothed, with calli; claw less than 2 mm long, lacking appendages; lamina calli sessile or stalked, usually numerous in two or more longitudinal rows or a central cluster. *Column* erect or incurved, 2-winged usually with prominent auricular lobes in the upper part and terminating in a definite point. *Anther* terminal, oblique, 2-celled, valvate. *Pollinia* 4, kidney-shaped, flat, mealy-granular. *Stigma* immediately below anther, circular, entire and disc-like. *Rostellum* poorly developed, viscid disc and caudicle absent.

Notes. The genus *Caladenia* may well be far older than first thought. With representatives of subgenus *Caladenia* in New Caledonia and New Zealand, which drifted away from the Australian plate in the Cretaceous, it is possible that *Caladenia* arose more than 60 million years ago. This assumes that dispersal of seeds and successful colonization over long distances, especially across the sea, are most unlikely. Alternatively, long distance dispersal would have to be invoked to explain contemporary geographical range, and a younger age is possible under this scenario.

It is clear from morphological and DNA studies that *Caladenia* subg. *Caladenia* is basal to the evolutionary radiation of this diverse genus. Only one possible species of this subgenus, *Caladenia saccharata* H.G. Reichb., occurs in Western Australia. It is possible that many others became extinct as rainforest diminished and ultimately disappeared from the south-west in the mid to late Tertiary. An early subsequent offshoot is *Caladenia* subg. *Elevatae*, best represented in the south-west where four

of the five species are endemic. Ranging across southern Australia west and east of the Nullarbor, *Caladenia* subg. *Phlebochilus* contains a diverse mix of species, many adapted to pollination through deceiving male thynnid wasps. This evolutionary direction reaches its zenith in *Caladenia* subg. *Drakonorchis*, all four species of which are endemic to south-western Australia. *Caladenia* subg. *Calonema*, also highly derived, contains a large radiation of spider orchids distributed in south-western and south-eastern Australia.

Caladenia is most closely related to the *Cyanicula*–*Glossodia* R. Br.–*Elythranthera* A.S. George clade, from which it differs in having new tuberoids produced on extended droppers, each tuberoid naked basally, with a few-layered tunica above, and the basal cell of hairs noticeably enlarged. From *Cyanicula*, *Caladenia*, also differs in the absence of blue petals and sepals. *Elythranthera* and, to a lesser extent *Glossodia*, have glossy flowers not seen in *Caladenia*.

The five subgenera and 112 species of south-western *Caladenia* are distinguished in the following keys. Subspecies are keyed out under the treatment of relevant species.

Key to subgenera of *Caladenia*

- 1. Labellum lamina hirsute above, insectiform, lacking capitate calli..... subg. **Drakonorchis**
- 1: Labellum lamina glabrous above, trilobed or triangular, with capitate calli
- 2. Labellum with lamina calli connate at base, held aloft in a linear, semicircular or horseshoe pattern on the perimeter of a callus plate..... subg. **Elevatae**
- 2: Labellum with lamina calli free at base, inserted directly into lamina surface
- 3. Petals less than 2 cm long, held more or less horizontally and usually curved forwards..... subg. **Caladenia**
- 3: Petals usually longer than 2 cm, held obliquely or vertically downwards or upwards, and backwards, rarely more or less horizontal
- 4. Labellum with lamina calli in 4 or more well spaced or densely aggregated rows..... subg. **Calonema**
- 4: Labellum with lamina calli in 2 well spaced rows or densely aggregated without rows evident..... subg. **Phlebochilus**

Key to south-west Australian species of *Caladenia*

Note. The vast majority of measurements are for fresh floral parts and leaves flattened beneath clear magic tape.

- 1. Labellum lamina hirsute above, insectiform, lacking capitate calli
- 2. Labellum lamina (head to tail) more than 11 mm when flattened
- 3. Horns on labellum claw medially located, reclined and well removed from the head; abdomen of labellum lamina narrowly elliptic and 9–14 x 3–7 mm when flattened **C. mesocera**
- 3: Horns on labellum claw distally located, curving forward either side of the head; abdomen of labellum lamina ovate and 7–11 x 5–7 mm

- when flattened **C. barbarossa**
- 2: Labellum lamina (head to tail) less than 9 mm when flattened
- 4: Labellum claw loosely hinged, claw connection 3–4 mm long; lamina held below the top of the ovary **C. drakeoides**
- 4: Labellum claw stiffly hinged, claw connection c. 1 mm long; lamina held above the top of the ovary **C. barbarella**
- 1: Labellum lamina glabrous above, trilobed or triangular, with capitate calli
- 5: Labellum entire or with marginal calli less than 1 mm long
- 6: Labellum margins entire (sometimes the apical midlobe has a few minute fringe segments)
- 7: Lateral sepals with swollen apical osmophores
- 8: Lateral sepals prominently falcate with an upturned apex
- 9: Lateral lobes of labellum lamina obtuse; central lobe narrowly triangular. West of Ongerup **C. integra**
- 9: Lateral lobes of labellum lamina shortly acute; central lobe broadly obtuse. East of Esperance **C. exstans**
- 8: Lateral sepals straight or slightly falcate but with a downturned apex
- 10: Petals erect, with swollen apical osmophores
- 11: Calli in two rows on labellum lamina **C. sigmoidea**
- 11: Calli aggregated into a broad central longitudinal band **C. macrostylis**
- 10: Petals splayed downwards, tapering to acute apices
- 12: Labellum lamina with prominent broad red stripes; calli in two rows **C. wanosa**
- 12: Labellum lamina with faint slender stripes; calli aggregated in a single row
- 13: Dorsal sepal usually with a swollen apical osmophore. Lateral sepals with a thickened osmophore 3–5 mm long **C. incrassata**
- 13: Dorsal sepal tapering to acute apex. Lateral sepals with a slender osmophore usually less than 3 mm long
- 14: Labellum 14–20 mm wide, green or yellow green, lacking prominent veins; calli thickened, conspicuously glossy **C. roei**
- 14: Labellum 12–16 mm wide, greenish-yellow with prominent dark red veins; calli slender, dull
- 15: Lateral sepals abbreviated, tapering evenly to the apical osmophore, rarely with a narrow filiform section to 3 mm long subtending the osmophore. Calli in a broad band c. 2 mm wide. Between Ravensthorpe and Israelite Bay **C. brevisura**
- 15: Lateral sepals elongated with a narrow filiform section 6–12 mm long subtending the apical osmophore. Calli in a narrow band c. 1 mm wide. West of Ravensthorpe **C. douthiae**
- 7: Lateral sepals tapering to apex
- 16: Petals and sepals white. Labellum with or without prominent lobes
- 17: Labellum prominently trilobed, lateral lobes with numerous bluish-grey veins **C. saccharata**
- 17: Labellum rhomboidal, lacking prominent lateral lobes and veins **C. dorrienii**

- 16: Petals and sepals red, yellow or green. Labellum prominently trilobed
- 18: Lateral sepals falcate with upturned apex. Labellum claw 2–3 mm long; lamina tremulous **C. multiclavia**
- 18: Lateral sepals straight or with downturned apex. Labellum claw 0–1 mm long; lamina firmly held
- 19: Lateral sepals 3–6 cm long; dorsal sepal arching backwards away from column **C. radialis**
- 19: Lateral sepals less than 2.5 cm long; dorsal sepal erect
- 20: Margins of labellum apex with thickened red callus
- 21: Labellum 7–12 mm long, 6–8 mm wide, faintly veined **C. pachychila**
- 21: Labellum 10–16 mm long, 9–12 mm wide, prominently veined **C. cairnsiana**
- 20: Margins of labellum apex not thickened
- 22: Labellum green, 4–6 mm wide **C. bryceana**
- 22: Labellum cream or brown with faint pink veining, 9–12 mm wide
- 23: Labellum transversely oval with a triangular apex, creamy green with pink veins and suffusions; calli wedge-shaped, to 1.5 mm tall, with pink top **C. voigtii**
- 23: Labellum cordiform, brown with faint pink veins; calli capitate, to 2 mm tall, with blackish purple top **C. cristata**
- 6: Labellum margins with several (rarely few) fringe segments or serrations less than 1 mm long
- 24: Calli densely aggregated into a central linear group on labellum lamina
- 25: Petals and sepals with swollen apical osmophore **C. ensata**
- 25: Petals and sepals with tapering filiform apex **C. radialis**
- 24: Calli in 2 or more distinct rows on labellum lamina
- 26: Calli in 4 or more distinct rows
- 27: Labellum apex dark maroon. Flowering May to July **C. drummondii**
- 27: Labellum apex white or pink. Flowering July to November **C. hirta**
- 26: Calli in 2 distinct rows
- 28: Dorsal sepal arching backwards away from column. Calli 2–5 across in each row **C. radialis**
- 28: Dorsal sepal erect, appressed to column. Calli singular in a linear series in each row
- 29: Lateral sepals less than 4 cm long
- 30: Petals and sepals obtuse or very shortly acute, apex scarcely hirsute
- 31: Petals and sepals cream **C. marginata**
- 31: Petals and sepals pink
- 32: Lateral sepals united in basal half **C. nana**
- 32: Lateral sepals free in basal half **C. reptans**
- 30: Petals and sepals long acuminate, apex prominently hirsute and finely acute
- 33: Labellum distal margins entire or sparsely serrate with few

- widely-spaced marginal calli
- 34. Flowers pale yellow-cream to white with maroon lines, spots and blotches. Lateral sepals incurved and crossed in front of ovary **C. dorrienii**
 - 34: Flowers golden yellow with dark maroon to brown stripes and markings. Lateral sepals held apart..... **C. caesarea**
 - 33: Labellum margins serrate with closely packed marginal calli
 - 35. Petals and sepals pale pinkish red to maroon **C. footeana**
 - 35: Petals and sepals yellow or cream with median red stripes
 - 36. Petals and sepals yellow with median red stripes
 - 37. Petals and sepals golden yellow. Labellum golden yellow with red veins; calli white. Mogumber to Kendenup in wandoo woodlands **C. xantha**
 - 37: Petals and sepals lemon yellow. Labellum white with thick dark radiating basal lines becoming large irregular spots and blotches towards the recurved apex; calli white with pink suffusions. Cosy Corner to William Bay in south coastal heath **C. abbreviata**
 - 36: Petals and sepals cream with median red stripes
 - 38. Hairs on petal and sepal apices hemispherical to shortly cylindrical. Central wheatbelt salt lake margins **C. melanema**
 - 38: Hairs on petal and sepal apices elongate, cylindrical. Coastal calcareous soils
 - 39. Leaf more than half the length of scape. Labellum 6–9 x 5–7 mm, apex evenly recurved. Widespread from Kalbarri to east of Esperance (also in South Australia) **C. bicallata**
 - 39: Leaf less than half the length of scape. Labellum to 14 x 7 mm, apex thrust outwards. Confined to the Peaceful Bay area of the south coast **C. evanescens**
 - 29: Lateral sepals longer than 4 cm
 - 40. Labellum lamina and calli entirely blood red, or rarely with cream near base
 - 41. Sepals and petals stiffly held near base with a lax apex, linear-lanceolate in basal 1/9–1/7, 5–10 cm long. Labellum lamina 10–15 x 6–10 mm, with lamina calli extending about 1/3–1/2 the length of the lamina **C. filifera**
 - 41: Sepals and petals stiffly held throughout, linear-lanceolate in basal 1/7–1/3, 3–6.5 cm long. Labellum lamina 5.5–10 x 2.5–6 mm, with lamina calli extending about 2/3–4/5 the length of the lamina
 - 42. Lateral sepals 5.5–6.5 cm x 2–3 mm. Labellum cream basally with prominent blood red radiating lines, becoming uniformly red towards apex; lamina 7–10 x 4–6 mm **C. dundasiae**

- 42: Lateral sepals 4.5–5 cm x c. 1.5 mm. Labellum blood red; lamina 5.5–6 x 2.5–3 mm **C. erythrochila**
- 40: Labellum lamina and calli cream or yellow with red-pink to brown veins and suffusions
- 43: Labellum erect with entire margins in basal 2/5; lamina narrowly rhomboidal when flattened. Cylindrical hairs on petal and sepal apices inconspicuous, 0.1–0.2 mm long **C. denticulata**
- 43: Labellum erect with entire margins in basal 1/3; lamina rhomboidal (rarely narrowly) when flattened. Cylindrical hairs on petal and sepal apices conspicuous to naked eye, 0.2–0.5 mm long
- 44: Winter-flowering, between June and August (peaking in July)
- 45: Leaf to 12 mm wide, more than half the length of the scape. Labellum 7–10 mm wide. Windy Harbour to Walpole on the south coast **C. meridionalis**
- 45: Leaf to 4 mm wide, less than half the length of the scape. Labellum 5–9 mm wide. Wheatbelt from Jurien to Katanning
- 46: Lateral sepals uniformly white with longitudinal red stripes; lamina 3–6 cm x 1.5–2 mm. Labellum 8–12 x 5–8 mm. Mt Lesueur to Katanning **C. hiemalis**
- 46: Lateral sepals white to pinkish maroon with longitudinal red stripes; lamina 5.5–9 cm x 2–3 mm. Labellum 11–13 x 7–9 mm. Coomberdale to Wannamal **C. exilis**
- 44: Spring-flowering, between August and December (peaking in August, September, October or November)
- 47: Flowering late October to December
- 48: Petals and sepals stiffly arching out and downwards, predominantly cream. Labellum erect with entire margins in the basal 2/5, nearly horizontal in the middle 2/5, with the apical 1/5 sharply recurved **C. postea**
- 48: Petals and sepals stiffly spreading, predominantly pale lemon yellow. Labellum erect with entire margins in basal 1/3, nearly horizontal in middle 1/3, with apical 1/3 sharply recurved **C. ultima**
- 47: Flowering August to early October
- 49: Leaf laterally flattened, 4–10 mm wide. Petals and sepals stiffly held
- 50: Flowers bright white with maroon lines, spots and blotches. Lamina calli creamy-white with pale pink markings, glossy on top **C. incensa**
- 50: Flowers cream to creamy-yellow, with pale brown lines, spots and blotches. Lamina calli cream to pale brownish yellow, dull on top **C. horistes**
- 49: Leaf laterally somewhat revolute, 2–5 mm wide. Petals and sepals usually lax, sometimes stiffly held
- 51: Labellum 12–16 mm wide when flattened

52. Flowers rich maroon or yellow (rarely cream) with suffusions of maroon; labellum with thick dark maroon radiating lines on a creamy-yellow background **C. chapmanii**
- 52: Flowers cream, with pale maroon lines, spots and blotches; labellum cream with pale maroon radiating basal lines, blotches and markings **C. nobilis**
- 51: Labellum 4–12 mm wide when flattened
53. Labellum 4–5 mm wide when flattened **C. microchila**
- 53: Labellum 5–12 mm wide when flattened
54. Gaps between fringe segments on labellum margin greater than width of segments
55. Labellum golden-yellow with thick stripes **C. caesarea**
- 55: Labellum lemon-yellow to cream with thin stripes **C. luteola**
- 54: Gaps between fringe segments on labellum margin less than or equal to width of segments
56. Labellum golden yellow with red veins; calli pure white **C. xantha**
- 56: Labellum cream with red veins and suffusions; calli cream, usually with pink markings on top
57. Petals and sepals consistently white (rarely pale yellow). Labellum lamina calli slender, erect, white with pink suffusions on top
58. Labellum 5–7 mm wide when flattened
59. Labellum rhomboidal in outline when flattened. Margins of salt lakes and water courses **C. exilis**
- 59: Labellum linear-rhomboidal to narrowly triangular in outline when flattened. Seasonally damp sites near granite outcrops or lateritic hills **C. paradoxa**
- 58: Labellum 7–12 mm wide when flattened
60. Leaf 5–7 mm wide. Inland distribution between Yalgoo, Eurady Station and Bonny Rock **C. remota**
- 60: Leaf 3–5 mm wide. Western wheatbelt to near-coastal areas
61. Petals with a stiffly held obliquely descending apex. Labellum lamina 9–15 x 7–11 mm. Column 8–12 mm tall **C. vulgata**
- 61: Petals with a lax vertically descending apex. Labellum lamina 11–19 x 9–12 mm. Column 10–15 mm tall **C. pendens**
- 57: Petals and sepals variably dark red, pink, pale brownish yellow, pale yellow or cream. Labellum lamina calli either squat and flattened or slender and erect, uniformly coloured
62. Labellum 10–13 mm wide when flattened **C. polychroma**
- 62: Labellum 6–10 mm wide when flattened
63. Petals and sepals bright lemon yellow. Calli glossy on top. North-west of Northampton **C. elegans**

- 63: Petals and sepals cream, white, pale yellow or dark red.
Calli dull on top. South-east of Geraldton
- 64. Flowers pale brownish yellow; labellum with
prominent dark maroon veins and blotches.
Green Range area east of Manypeaks **C. fuscolutescens**
- 64: Flowers variably dark red, pink, pale yellow or
cream. North-west to north-east of Green Range area
- 65. Labellum 9–12 mm wide when flattened **C. pendens**
- 65: Labellum 6–9 mm wide when flattened
- 66. Lateral sepals and petals with a lax apex **C. pulchra**
- 66: Lateral sepals and petals with a stiffly held apex
- 67. Labellum with prominent radiating maroon
stripes and markings. Paynes Find south-east
through the wheatbelt to Esperance **C. dimidia**
- 67: Labellum with faint pinkish red to maroon
radiating basal stripes. Near west coast from
Dongara to south of Mandurah **C. occidentalis**
- 5: Labellum fimbriate with marginal calli longer than 1 mm
- 68. Sepals short; apex lacking thickened osmophore, not prominently
hirsute, acuminate
- 69. Labellum ovate, with numerous filiform marginal calli **C. discoidea**
- 69: Labellum trilobed, with less than 10 thickened marginal calli
- 70. Flowers yellow with red markings **C. flava**
- 70: Flowers pink, rarely white **C. latifolia**
- 68: Sepals long-acuminate; apex with thickened osmophore or prominently
hirsute and finely acute
- 71. Sepal apices with thickened osmophore, covered in hemispherical glands
- 72. Lateral sepals prominently falcate, with an upturned apex
- 73. Rear lobes of labellum lamina slightly descending, with numerous
filiform marginal calli curving obliquely upwards **C. lobata**
- 73: Rear lobes of labellum lamina ascending, with few erect thickened
marginal calli
- 74. Labellum white adjacent to the dark maroon apex **C. longifimbriata**
- 74: Labellum green adjacent to the dark maroon apex
- 75. Lamina calli stopping short of the dark maroon apex of the labellum **C. falcata**
- 75: Lamina calli reaching and sometimes extending onto the dark
maroon apex of the labellum **C. attingens**
- 72: Lateral sepals straight or slightly falcate, with apex splayed downwards
- 76. Petal apex with an osmophore, covered in hemispherical glands
- 77. Labellum 11 mm or more wide
- 78. Calli aggregated into a single longitudinal mass occupying
about a third of the width of the labellum lamina **C. longiclavata**
- 78: Calli in 4 or more distinct longitudinal rows with a clear median
gap, together occupying about half the width of the labellum lamina

- 79. Petals with a lax pendulous apex **C. heberleana**
- 79: Petals usually with a stiff, splayed, often obliquely ascending apex
- 80. Petals always with a thickened osmophore. Flowering October to December. Southern forests from Dunsborough to Albany
- 81. Labellum white to pale yellow with maroon radiating stripes; apex cream **C. lodgeana**
- 81: Labellum pale green with maroon radiating stripes; apex dark maroon **C. brownii**
- 80: Petals only occasionally with a thickened osmophore. Flowering August to October. Swan Coastal Plain between Lancelin and Yarloop, or southern heathlands from Fitzgerald River National Park to east of Esperance
- 82. Petals obliquely ascending. Osmophores on sepals noticeably tumescent, often more than 1 mm diam., light yellowish-brown. Southern heathlands from Fitzgerald River National Park to east of Esperance **C. decora**
- 82: Petals horizontal to somewhat downcurved. Osmophores on sepals scarcely tumescent, always less than 1 mm diam., light brown. Swan Coastal Plain between Lancelin and Yarloop **C. arenicola**
- 77: Labellum less than 11 mm wide
- 83. Longest labellum marginal calli 7–10 mm. Flowering late November to January **C. corynephora**
- 83: Longest labellum marginal calli 1–5 mm. Flowering August to October
- 84. Petals erect. Lamina calli arranged in two pairs of distinct rows with a clear gap between them **C. arrecta**
- 84: Petals downcurved to horizontal. Calli arranged in closely adjacent rows without a clear gap between them
- 85. Labellum extended, crescent-shaped in side-view, white. Murchison River to Geraldton and the Pingaring area **C. hoffmanii**
- 85: Labellum evenly and fully recurved in side-view, creamy yellow to greenish yellow. Forests and adjacent wheatbelt from near Perth southwards
- 86. Longest labellum marginal calli less than 2 mm long **C. ensata**
- 86: Longest labellum marginal calli 2–5 mm long
- 87. Scapes to 35 cm tall. Osmophores on petals and sepals about a third the length of the lamina. Petals stiffly splayed outwards with a slightly downcurved apex. Labellum to 15 mm long, with few thick well-spaced short marginal calli **C. longiclavata**
- 87: Scapes to 60 cm tall. Osmophores on petals and sepals about a half the length of the lamina. Petals stiffly curving obliquely downwards to a vertical apex. Labellum to 12 mm long, with several thin closely arranged long marginal calli **C. magniclavata**

- 76: Petal apex lacking an osmophore, not glandular
88. Labellum apex pale, the same colour as basal lamina
89. Lateral sepals pale yellow, less than 5.5 cm long.
North of Margaret River ***C. busselliana***
- 89: Lateral sepals cream, often with pale pink suffusions, more
than 5.5 cm long. Windy Harbour to Walpole ***C. interjacens***
- 88: Labellum apex dark maroon or dark pink, contrasting with pale
basal lamina
90. Calli aggregated into a single longitudinal band of closely
appressed rows on labellum lamina
91. Lateral sepals less than 2.5 cm long. Labellum lamina
6–7 x 5–6 mm ***C. plicata***
- 91: Lateral sepals more than 2.5 cm long. Labellum lamina
14–20 x 6–15 mm
92. Longest labellum marginal calli 1–3 mm long ***C. rhomboidiformis***
- 92: Longest labellum marginal calli 4–7 mm long
93. Calli numerous (20+) across the 4–6 mm wide
longitudinal band. Arrowsmith River–Greenough area ***C. crebra***
- 93: Calli few (2–5) across the 2–3 mm wide longitudinal band.
Southern forests to Esperance
94. Labellum crescentic in side view with the apex thrust
obliquely downwards; calli 2 across the longitudinal
band ***C. graminifolia***
- 94: Labellum evenly recurved in side view with the apex curled
under the main lamina; calli 3–5 across the longitudinal band
95. Labellum lamina parallel-sided, yellowish green adjacent
to the dark maroon apex. Southern forests ***C. radiata***
- 95: Labellum lamina prominently trilobed, white adjacent
to the dark maroon apex. Jerramungup to Esperance ***C. longifimbriata***
- 90: Calli in 4 or more distinct longitudinal rows with a clear median gap
96. Sepals and petals pale to dark pink or reddish-pink
97. Sepals and petals reddish-pink; osmophore light brown,
about 1 mm diam. ***C. applanata***
- 97: Sepals and petals pale to dark pink; osmophore greyish-pink,
less than 1 mm diam.
98. Column 13–16 mm tall. Sepals and petals dark pink.
Basal section of labellum lamina pale pink with prominent
to inconspicuous pink radiating stripes. Tone River area ***C. winfieldii***
- 98: Column 16–20 mm tall. Sepals and petals pale to dark pink.
Basal section of labellum lamina white to pale pink with
inconspicuous pink radiating stripes
99. Lateral sepals usually acutely downcurved. Petals
3.0–5.5 cm long. Near-coastal well-drained sands, Yallingup
to William Bay ***C. gardneri***

- 99: Lateral sepals usually splayed out at 45° below horizontal before drooping vertically. Petals 3.0–3.5 cm long. Inland winter-wet clay-loams, Lake Muir east to Porongurups **C. starteorum**
- 96: Sepals and petals greenish or yellowish cream with maroon suffusions or completely maroon
100. Labellum lamina calli not reaching the red-maroon apex
101. Lateral sepals brownish red. Labellum evenly downcurved, the basal margins and fringe splayed upwards; marginal calli usually more than 5 mm long **C. ferruginea**
- 101: Lateral sepals greenish-yellow. Labellum flattened, thrust outwards, curved downwards only a short distance from the apex, with fringe splayed laterally; marginal calli usually less than 5 mm long
102. Lateral sepals 4.5–6.5 cm long. Labellum greenish-yellow with red-maroon apex. Leeuwin–Naturaliste Ridge to Pemberton **C. infundibularis**
- 102: Lateral sepals 3.5–4 cm long. Labellum white. Albany to Cheyne Beach **C. granitora**
- 100: Labellum labellum calli extending onto the red-maroon apex
103. Labellum marginal calli thickened, stout, usually less than 5 mm long, terminating in an enlarged club-like apex
104. Lateral sepals and petals white, rarely suffused pink. Labellum fringe usually no more than 2 mm long **C. nivalis**
- 104: Lateral sepals and petals greenish yellow with red- brown maroon markings. Labellum fringe usually more than 2 mm long
105. Lateral sepals and petals usually with prominent red-maroon markings. Labellum lamina flattened in cross-section near the base. Near-coastal calcareous soils **C. applanata**
- 105: Lateral sepals and petals usually greenish-yellow with inconspicuous brownish-maroon markings. Labellum lamina crescentic in cross-section near the base. Inland acidic soils
106. Lateral sepals usually splayed out at 30°–45° below horizontal. Labellum lamina broadly pear-shaped. Winter-wet clay-loams near Gingin south to Gracetown **C. paludosa**
- 106: Lateral sepals usually splayed horizontally. Labellum lamina narrowly pear-shaped. Well-drained gravelly sands near Cape Naturaliste **C. viridescens**
- 103: Labellum marginal calli slender, filiform, usually longer than 5 mm long, terminating in a finely acute apex
107. Labellum apex noticeably channelled, often not fully recurved; marginal calli up to 15 mm long, sometimes bifurcate . **C. huegelii**
- 107: Labellum apex not noticeably channelled, usually fully recurved; marginal calli usually up to 10 mm long, not bifurcate
108. Lateral sepals with a slightly tumescent osmophore

109. Flowers predominantly yellowish-green. Longest marginal calli on labellum 6–12 mm. Near-coastal on yellow Karrakatta sands ***C. georgei***
- 109: Flowers predominantly red maroon. Longest marginal calli on labellum 4–8 mm. Mainly inland on grey Bassendean sands ***C. arenicola***
- 108: Lateral sepals with a prominently tumescent osmophore
110. Lateral sepals c. 4 cm x 3 mm. Deep sand ***C. thinicola***
- 110: Lateral sepals usually 5–8 cm x 4–9 mm. Sandy clay-loams
111. Scape 35–70 cm tall, flowers predominantly greenish lemon yellow. South-west of Busselton ***C. procera***
- 111: Scape 25–50 cm tall, flowers predominantly reddish (rarely greenish) yellow. Cataby to Boyup Brook and to east of Esperance
112. Flowers usually red maroon. Petals usually with an osmophore 10–22 mm long. Fitzgerald River National Park east to Cape Arid National Park ***C. decora***
- 112: Flowers usually reddish yellow. Petals lacking an osmophore; Cataby to Boyup Brook and Fitzgerald River National Park ***C. pectinata***
- 71: Sepal apex finely acute, prominently hirsute with cylindrical trichomes
113. Labellum lamina two-coloured with a dark maroon apex
114. Petals and sepals uniformly pink ***C. harringtoniae***
- 114: Petals and sepals white, cream or greenish with red-pink markings
115. Labellum extended, crescent-shaped in side view. Murchison River to the Pingaring area ***C. hoffmanii***
- 115: Labellum evenly and fully recurved in side view. South-western forest areas, western wheatbelt margins, and western coastal plains
116. Labellum narrow (8–11 mm wide) with short marginal calli to 4 mm long ***C. uliginosa***
- 116: Labellum broad (10–17 mm wide) with long marginal calli to 5–10 mm long
117. Lateral sepals 13–20 cm long. Labellum lamina 25–35 mm long. Leeuwin–Naturaliste Ridge ***C. excelsa***
- 117: Lateral sepals 6–10 cm long. Labellum lamina 17–27 mm long. Gingin to Leeman, and Capel area ***C. lorea***
- 113: Labellum lamina uniformly coloured
118. Petals, sepals and labellum lamina pale lemon yellow
119. Lateral sepals arching to pendulous, narrow (3.5–5 mm wide near base). Labellum narrow (7–10 mm wide). Flowering late November to January ***C. pholcoidea***
- 119: Lateral sepals stiff and spreading, broad (5–7 mm wide near base). Labellum broad (10–14 mm wide). Flowering late September to October ***C. citrina***
- 118: Petals, sepals and labellum lamina usually creamy white with

- red-maroon or pinkish markings
120. Labellum marginal calli often bifurcating and long (to 7–12 mm).
Flowers white with faint pink suffusions **C. speciosa**
- 120: Labellum marginal calli linear and short to long (2–14 mm).
Flowers white or marked with prominent red-maroon lines and suffusions
121. Petals, sepals and labellum lamina often with prominent red-maroon or pinkish markings. Flowering late November to January **C. serotina**
- 121: Petals, sepals and labellum usually creamy-white, rarely with red-maroon or pinkish markings. Flowering August to early November
122. Labellum marginal calli to 2–5 mm long
123. Labellum 3–5 mm wide. Petals and sepals 5–7 cm long.
Coastal and high rainfall forest areas **C. christineae**
- 123: Labellum 7–11 mm wide. Petals and sepals 3–5 cm long.
Salt lake margins and moist depressions north of Esperance **C. cruscula**
- 122: Labellum marginal calli to 4–14 mm long
124. Labellum lamina 20–35 x 12–20 mm **C. splendens**
- 124: Labellum lamina 12–30 x 6–18 mm **C. longicauda**

1. *Caladenia* R. Br. subgenus *Caladenia*

Petals less than 2 cm long, held c. horizontally and usually curved forward. *Labellum*: claw minute, less than 0.5 mm long, lacking paired horn-like appendages; lamina glabrous above, 3-lobed or triangular, with capitate calli free at base, inserted directly into lamina surface, in 2 or more well spaced or densely aggregated rows.

Notes. *Caladenia* subgenus *Caladenia* has approximately 40 named species, mostly Australian, but a few ranging from New Zealand to New Guinea, Indonesia, Malaysia, and New Caledonia, with one endemic in south-western Australia. Eastern Australian members of the subgenus are under active revision by D.L. Jones (1991, 1998, 1999), and are in need of detailed analysis to resolve relationships.

Known collectively as fairy orchids, members of *Caladenia* subgenus *Caladenia* are closest morphologically to *Caladenia* subgenus *Elevatae*. The distinctive forward curving short petals and simple calli are diagnostic for most species of subgenus *Caladenia*.

Recent DNA sequence studies of the *Caladenia* alliance in the Diurideae (Kores *et al.*, unpublished) established that these two subgenera are distinct clades basal to the genus as a whole. A comprehensive study of the fairy caladenias is needed to further clarify relationships.

As noted in the introduction, Bentham (1873) included in this typical section of *Caladenia* (here recognized as subgenus *Caladenia*) a heterogeneous amalgamation of several independent groups now placed widely apart, including members of *Praecoxanthus*, *Cyanicula*, *Lyperanthus* R. Br. and *Caladenia* subgenus *Elevatae*.

A single Western Australian species, *Caladenia saccharata*, is tentatively placed in subgenus *Caladenia* pending further information from DNA sequence studies, but this differs significantly from other members of the subgenus in labellum characters and the presence of dark glandular floral

hairs. *C. saccharata* is adequately covered by previous descriptions (e.g. Hoffman & Brown 1992, 1998; Jones 1988).

2. *Caladenia* subgenus *Calonema* (Lindl.) Hopper & A.P. Br. [as (Benth.) Hopper & A.P. Br.], *Lindleyana* 15 (2): 124 (2000). – *Caladenia* § *Calonema* Lindl., Sketch Veg. Swan R. lii (1840). – *Caladenia* sect. *Calonema* [Lindl.] Benth., Fl. Austral 6 (1873: 381). *Type: Caladenia longicauda* Lindl., neoelectotype here selected (see note added in proof).

Petals usually more than 2 cm long, held obliquely or vertically downwards or upwards, and backwards, rarely *c.* horizontal. *Labellum*: claw less than 2 mm long, lacking paired horn-like appendages; lamina glabrous above, trilobed or triangular, with capitate calli free at base, inserted directly into lamina surface, in four or more well spaced or densely aggregated rows.

Notes. *Caladenia* subgenus *Calonema* has many species distributed across southern Australia, with 55 in Western Australia, all endemic to the south-west. In addition to the species treated below, the following Western Australian species belong to this subgenus: *Caladenia corynephora* A.S. George, *C. crebra* A.S. George, *C. discoidea* Lindley, *C. drummondii* Benth., *C. graminifolia* A.S. George, *C. lobata* W.V. Fitzg., *C. macrostylis* W.V. Fitzg., *C. plicata* W.V. Fitzg. and *C. radiata* Nicholls. These species have been adequately described previously (e.g. George 1971; Hoffman & Brown 1998)

When Bentham (1873) treated *Caladenia* sect. *Calonema*, he included species here placed in subgenus *Drakonorchis* and subgenus *Phlebochilus*. Recent DNA sequence studies of the *Caladenia* alliance (Kores *et al.* unpubl.) show that *Caladenia* subgenus *Calonema* as circumscribed here is the most derived clade in the genus. It includes all the spider orchids except for the *C. filamentosa* group, which is placed in subgenus *Phlebochilus*. In addition, some species lacking long petals and sepals are also placed in *Caladenia* subgenus *Calonema*, including *C. hoffmanii*, *C. discoidea* and *C. hirta*. All species in the subgenus have four or more well spaced or densely aggregated rows of calli on the labellum lamina.

Caladenia applanata* Hopper & A.P. Br., *sp. nov.

A speciebus ceteris gregis *Caladenia huegelii* H. G. Reichb. petalis sepalisque rigidus variabiliter lineatis et maculatis obscure marroninis ad roseis, sepalis lateralibus 4–8 cm longis et 3–6 mm latis cum clavis diluto-brunneis 10–40 mm longis, petalis patentibus ad plus minusve recurvatis, 3–5 cm longis et 2.5–4 mm latis sine clavis, labello rigido carnosio dorso-ventraliter plano, late pyriformi, 20–23 mm longo et 11–15 mm lato, lamina basali alba cum roero-lineata radiatim, labelli fimbria cum segmentis crasso-clavatis, atro-marroninis ad 4 mm longis differt.

Typus: Quarram Nature Reserve, 1 km west of Parry Inlet Beach, 24 km west-south-west of Denmark, 35°03'S, 117°10'E, Western Australia, 7 October 1984, S.D. Hopper 4257 (*holo*: PERTH 00267023; *iso*: AD!, CBG!, K!, MEL!).

Plant solitary or in loose clumps. *Leaf* erect, linear, 9–20 cm x 4–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–50 cm tall. *Flowers* 1 or 2(3), *c.* 6–8 cm across, with variable suffusions, lines and spots of dull maroon to pink; floral odour faintly to strongly sweet or absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore 10–40 mm long, tumescent on sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4.5–8 cm x 2.5–3.5 mm. *Lateral sepals* spreading and downcurved, 4–8 cm x 3–6

mm. *Petals* horizontal to somewhat downcurved, 3–5 cm x 2.5–4 mm. *Labellum* fleshy, 3-lobed (sometimes obscurely), prominently 2-coloured, white with pink to red radiating stripes, terminating in a uniformly dark maroon to pink recurved apex, stiffly articulate on a claw 3–4 mm wide; lamina linear-cordate in outline when flattened, 20–23 x 11–15 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with stout clubbed narrowly fusiform dark maroon to pink (sometimes white-tipped) calli to 4 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon to pink, sometimes white at base, golf stick-shaped, decrescent towards apex and becoming sessile. *Column* 15–20 x 7–12 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 4 x 4 mm, dark maroon to pink. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 4–5 mm wide, yellow-green. *Capsule* not seen.

Distribution and habitat. Occurs from Cape Naturaliste south to Augusta and east to the Albany area, always within a few kilometres of the coast. Grows in heath and Peppermint low woodlands on consolidated coastal dunes and limestone outcrops in well drained soil.

Flowering period. September to October.

Etymology. Named from the Latin *applanatus* (flattened or horizontally expanded), alluding to the flattened labellum.

Notes. A common coastal species in the *Caladenia huegelii* complex with robust fleshy flowers of variable colouration, most closely allied to *C. paludosa*, but differing in its larger dull maroon to pink petals and sepals, longer clubs (to 40 mm), a more flattened labellum with the basal lamina white with pink to red radiating stripes, and its near-coastal habitat in well drained soils.

Plants east of Albany (e.g. Two Peoples Bay Nature Reserve *CSIRO* 77, PERTH 00793310) resemble *C. applanata* but have erect lateral lobes on the labellum. Their status requires further investigation.

We recognize two subspecies within *Caladenia applanata*. These differ in colour and other minor morphological characters. They grow sympatrically in William Bay National Park with different but overlapping flowering times, and also appear to differ in their response to fire (see below).

Key to subspecies of *Caladenia applanata*

1. Flowers dull maroon with cream markings and suffusions
Labellum lamina with calli to 3 mm tall subsp. **applanata**
- 1: Flowers uniformly pale pink. Labellum lamina with calli to 2 mm tall subsp. **erubescens**

Caladenia applanata Hopper & A.P. Br. subsp. **applanata**

Illustrations. W. Nicholls, *Orchids of Australia*, plate 252a [as *Caladenia pectinata* typical specimen] (1969); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 6B [as *C. huegelii*] (1984); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 101 (1992) and rev. 2nd edn with suppl., p. 101 (1998).

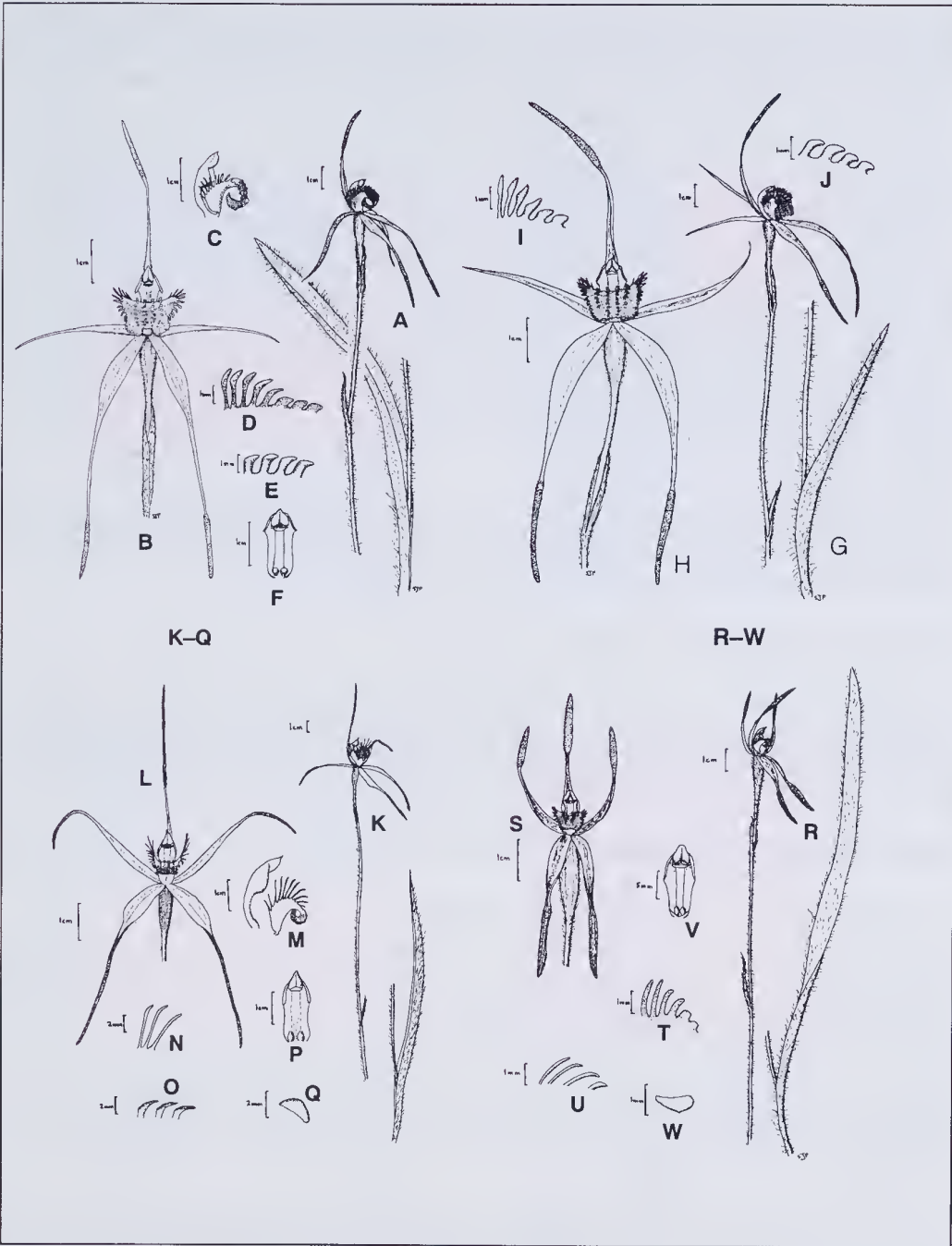


Figure 2 A-F. *Caladenia applanata* subsp. *applanata* from Quarram Nature Reserve, S.D. Hopper 4257. A – plant; B – flower; C – labellum and column from side; D – labellum fringe; E – calli; F – column from front. G-J. *C. applanata* subsp. *erubescens* from William Bay, S.D. Hopper 4252. G – plant; H – flower; I – labellum fringe; J – calli. K-Q. *C. arenicola* from Kelmscott, A.P. Brown 719. K – plant; L – flower; M – labellum and column from side; N – labellum fringe; O – calli; P – column from front; Q – pollinia. R-W. *C. arrecta* from the Margaret River area, S.D. Hopper 4289. R – plant; S – flower; T – labellum fringe; U – calli; V – column from front; W – pollinia. Drawn by S.J. Patrick.

Scape 25–50 cm tall. *Flowers* 1 or 2(3), dull maroon with cream markings and suffusions; floral odour absent. *Labellum* 3-lobed, white with red radiating stripes, terminating in a uniformly dark maroon recurved apex; lateral lobe with marginal calli dark maroon. *Lamina calli* to 3 mm tall. *Anther* maroon. (Figure 2A–F)

Selected specimens examined. WESTERN AUSTRALIA: 1.5 km N of Gracetown on Cowaramup Bay Rd, Leeuwin–Naturaliste National Park, 33°51'S, 114°59'E, 4 Oct. 1983, *S.D. Hopper* 3427 (PERTH 00267473); 5 km SW of Yallingup, 2 km S of Canal Rocks turnoff on Caves Rd, 33°41'S, 115°00'E, 5 Oct. 1983, *S.D. Hopper* 3449 (PERTH 00267015); William Bay National Park, 3.5 km W of Ocean Beach Rd on Mooney Valley Rd, 8 km SSW of Denmark, 35°01'S, 117°21'E, 7 Oct. 1984, *S.D. Hopper* 4253 (PERTH 00267066); Boat Harbour, 100 m NW of Shacks, 32 km ESE of Walpole, 29 km WSW of Denmark, 35°02'S, 117°05'E, 7 Oct. 1984, *S.D. Hopper* 4260 (CBG, PERTH 00267074); Moses Rock, 33°46'S, 114°59'E, 25 Sep. 1986, *S.D. Hopper* 5551 (PERTH 00874175); West Cape Howe National Park, 0.8 km due S of Lake William, 35°07'S, 117°36'E, 9 Oct. 1987, *S.D. Hopper* 6227 (PERTH 01667033); Cape Naturaliste Lighthouse, 33°32'S, 115°01'E, 28 Oct. 1985, *L. Nunn* 552 (PERTH 01709526).

Distribution and habitat. Occurs from Cape Naturaliste south to Augusta and east to the Albany area, always within a few kilometres of the coast. Grows in heath and Peppermint low woodlands on consolidated coastal dunes and limestone outcrops. (Figure 3B)

Flowering period. September to October.

Notes. This is the more common and widespread of the two subspecies of *Caladenia applanata*, occurring from Cape Naturaliste to the Albany area, and characterised by its dull maroon colours, absence of floral odour, more prominent lateral labellum lobes, longer calli on the labellum lamina; later flowering when sympatric, and ability to flower in abundance in the absence of fire.

***Caladenia applanata* subsp. *erubescens* Hopper & A.P. Br., subsp. nov.**

A subsp. *applanata* florum colore diluto-roseo differt.

Typus: William Bay National Park, 3.5 km west of Ocean Beach Rd on Mooney Valley Rd, 8 km south-south-west of Denmark, 35°01'S, 117°21'E, Western Australia, 7 October 1984, *S.D. Hopper* 4252 (*holo:* PERTH 00264083; *iso:* AD!, CBG!, K!, MEL!).

Illustrations. W. Stoutamire, *Aust. J. Bot.* 31: 385, figure 1A [as *Caladenia huegelii*] (1983); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 100 (1992) and rev. 2nd edn with suppl., p. 100 (1998).

Scape 25–40 cm tall. *Flowers* 1 or 2, pink with cream markings and suffusions; floral odour faintly to strongly sweet. *Labellum* obscurely 3-lobed, white with pink radiating stripes, terminating in a uniformly dark pink recurved apex; lateral lobe with marginal calli pink. *Lamina calli* to 2 mm tall. *Anther* pink. (Figure 2G–J)

Selected specimens examined. WESTERN AUSTRALIA: William Bay National Park, 12 km SW of Denmark, 7.5 km SE of Parryville, 32°05'S, 117°17'E, 7 Oct. 1984, *S.D. Hopper* 4255 (PERTH

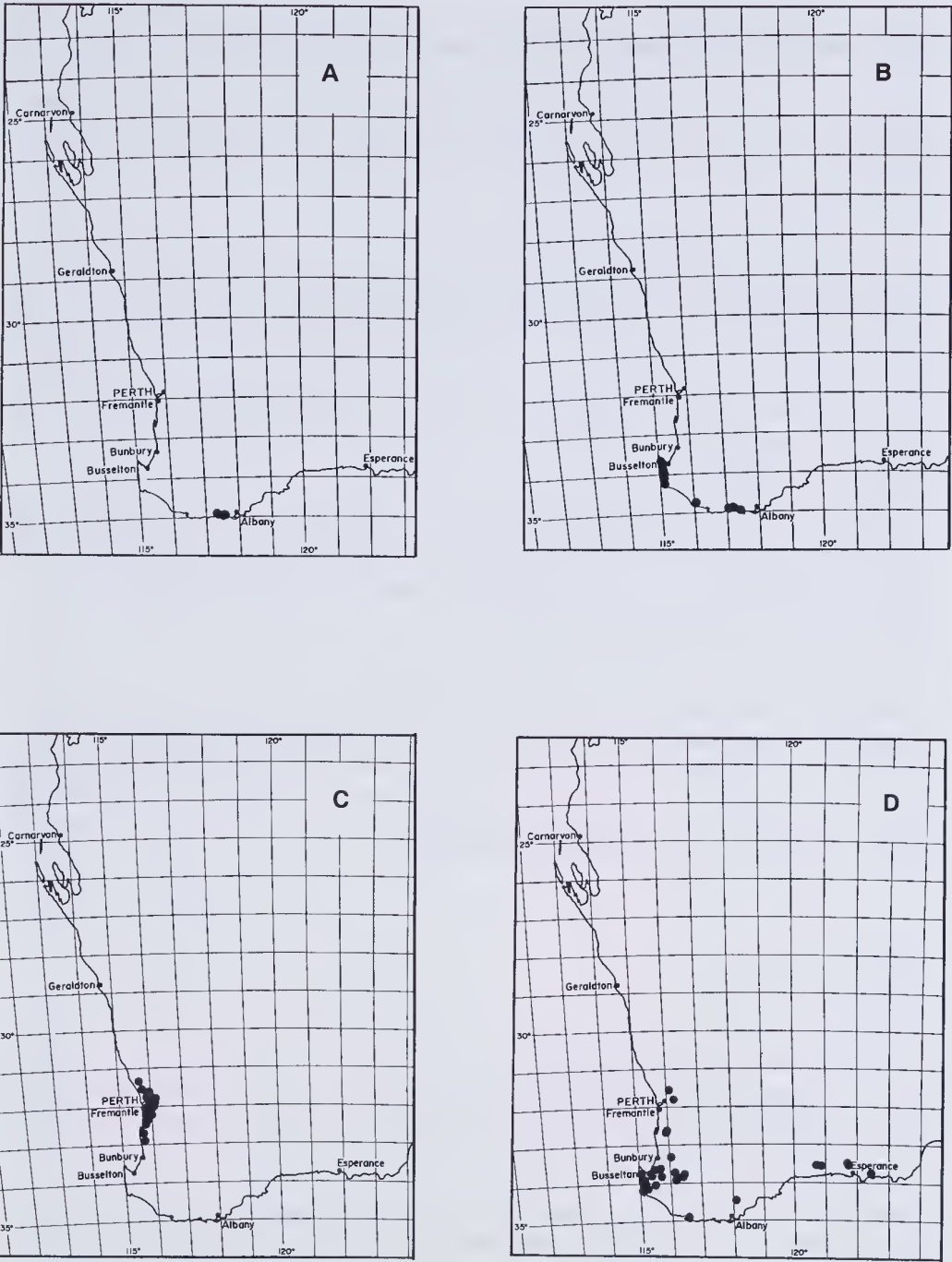


Figure 3. Distribution maps. A – *Caladenia applanata* subsp. *erubescens*; B – *C. applanata* subsp. *applanata*; C – *C. arenicola*; D – *C. arrecta*.

00909572); 3 km SW of Peaceful Bay store, 35°02'S, 116°55'E, 13 Nov. 1985, *S.D. Hopper* 4725 (PERTH 00908029); William Bay, 1964, *W. Rogerson* 276 (PERTH 00267481).

Distribution and habitat. Confined to coastal areas between William Bay and Peaceful Bay (west of Denmark), growing in heath and Peppermint low woodlands on consolidated coastal dunes. (Figure 3A)

Flowering period. September to early October.

Etymology. Named from the Latin *erubescens* (reddening, blushing, rose), alluding to the pink floral colouration which contrasts with the dull maroon of subsp. *applanata*.

Notes. Although locally common this subspecies has a very restricted distribution in the William Bay area. It differs from the nominate subspecies in its pink floral colours, sweet floral odour, obscure lateral labellum lobes, shorter labellum lamina calli, earlier flowering when sympatric, and flowering abundantly only after fire.

Caladenia applanata subsp. *erubescens* could be confused with *C. gardneri* due to its pink colouration, but it is a more robust plant with a much larger labellum and thicker darker clubs. *C. gardneri* and both subspecies of *C. applanata* have been found growing together.

***Caladenia arenicola* Hopper & A.P. Br., sp. nov.**

A speciebus ceteris gregis *Caladenia huegelii* H. G. Reichb. petalis sepalisque rigidis, variabilibus suffusionibus atro-marroninis, sepalis lateralibus 5–7.5 cm longis et 4–6 mm latis cum clavis diluto-brunneis 20–42 mm longis, petalis patentibus ad plus minusve recurvatis, 4–6 cm longis et 3–5 mm latis, plerumque cum clavis pergracilibus 12–25 mm longis, labello 18–28 mm longo et 12–17 mm lato, lamina basali alba cum lineis roseis radiantibus, labelli fimbria cum segmentis gracilibus acutis marroninis, saepe cum apicis albis ad 8 mm longis differt.

Typus: 2 km north of Ocean Reef Rd on the west side of Joondalup Drive [west of Wanneroo], 31°45'S, 115°48'E, Western Australia, 3 September 1985, *S.D. Hopper* 4478 (*holo:* PERTH 01751611; *iso:* AD!, CBG!, K!, MEL!).

Illustrations. R. Erickson, *Orchids of the West*, 2nd edn, frontispiece 4, [as *Caladenia pectinata*] (1965); E. Bennett, *The Bushland Plants of Kings Park Western Australia*, (figure 223, [as *C. huegelii*]; (1988); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 3 top left photo, [as *C. huegelii*] (undated); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 105 (1992) and rev. 2nd edn with suppl., p. 105 (1998).

Plant solitary or in loose clumps. *Leaf* 15–25 cm x 5–12 mm, linear, erect, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1 or 2(3), c. 6–8 cm across, predominantly red maroon to pale yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 20–42 mm long on sepals, 12–25 mm long (occasionally absent?) on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 5–7.5 cm x 2.5–3.5 mm.

Lateral sepals spreading and downcurved, 5–7.5 cm x 4–6 mm. *Petals* slightly ascending to somewhat downcurved, 4–6 cm x 3–5 mm. *Labellum* 3-lobed (sometimes obscurely), prominently 2-coloured, white with pink to red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 3 mm wide; lamina linear-cordate in outline when flattened, 18–28 x 12–17 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point deeply curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender slightly clubbed linear dark maroon (sometimes white-tipped) calli to 8 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 20–24 x 10–14 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 4 x 4 mm, dark maroon. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 4–5 mm wide, dark yellow-green. *Capsule* not seen. (Figure 2K–Q)

Selected specimens examined. WESTERN AUSTRALIA: Kewdale, 31°58'S, 115°58'E, 7 Sep. 1976, R. Coveny 8215 (NSW, PERTH 00341150); Mundaring, 30 Aug. 1944, C.A. Gardner s.n. (PERTH 00232610); s. loc., 5 Oct. 1932, B.T. Goadby s.n. (PERTH 00232556); Kelmscott, 11 Sep. 1897, R. Helms s.n. (PERTH 00232637); Canningvale, 10 km S of Thornlie Post Office, W side of corner of Wharton and Bullfinch Rds, 32°05'S, 115°28'E, 13 Sep. 1983, S.D. Hopper 3378 (CBG, PERTH 00237884); Leeming, c. 400 m S of South St, 32°04'S, 115°51'E, 21 Sep. 1983, S.D. Hopper 3396 (PERTH 00232114); Yalgorup National Park, 300 m W of Mandurah–Bunbury road, on Preston Beach Rd, 32°13'S, 115°43'E, 12 Sep. 1984, S.D. Hopper 4142 (PERTH 00232149); Parrot Ridge, Yanchep National Park, 50 km N of Perth, 23 Sep. 1989, G.J. Keighery 11167 (PERTH 01669109); Clifton Rd, Lake Clifton, 16 Sep. 1971, S. Paust 958 (PERTH 00233005); Cannington, 7 Oct. 1900, A. Purdie s.n. (PERTH 00328472); Nollamara, NE of intersection of Oliver St and Grand Promenade, 9 Sep. 1975, R. Tinetti s.n. (PERTH 00874647).

Distribution and habitat. Confined to the Bassendean Dunes of the Swan Coastal Plain inland from Lancelin and south to Yarloop. Grows in *Banksia*/Jarrah/*Allocasuarina* low woodland in deep well-drained sand. (Figure 3C)

Flowering period. Late August to October.

Etymology. Named from the Latin *arena* (sand, sandy place) and the suffix *-cola* (dweller, inhabitant), alluding to the dry sandy habitat occupied.

Notes. A locally common species of the *Caladenia huegelii* complex which has previously been treated as *C. pectinata* (e.g. Rye 1987) or as *C. huegelii* (e.g. Bennett 1988). It is allied to *C. lorea* and *C. georgei*. From *C. lorea*, it differs in its shorter stiffly held lateral sepals and petals with shorter osmophores, and its occurrence further south (except for the disjunct Capel population of *C. lorea*) in woodlands on the Swan Coastal Plain in Bassendean sands. The two species appear to hybridize in a narrow band in the Yeal Swamp area (north-east of Wanneroo) where their ranges overlap.

Caladenia arenicola differs from *C. georgei* in its longer petals usually with osmophores, its sepals with more slender osmophores, its shorter slightly clubbed labellum marginal calli, its usually darker colouration, and its more inland distribution on the Swan Coastal Plain Bassendean sands. *C. arenicola* hybridizes with *C. georgei* in a narrow band in the northern suburbs of Perth at the junction of the

Spearwood and Bassendean dunes (e.g. Joondalup area). Like many other members of the *C. huegelii* complex, *C. arenicola* also hybridizes occasionally with *C. longicauda* when sympatric.

Caladenia arenicola is still common in bushland remnants within highly developed urban areas such as Kings Park near Perth and Wireless Hill near Booragoon.

Caladenia arrecta Hopper & A.P. Br., *sp. nov.*

A speciebus ceteris gregis *Caladenia longiclavata* E. Coleman petalis sepalisque saepe atromarroninis suffusionibus, sepalis lateralibus 2–3.5 cm longis et 2–4 mm latis cum clavis 10–17 mm longis, petalis rigidis, 2–2.5 cm longis et 2–4 mm latis, cum clavis 5–10 mm longis, labello 12–14 mm longo et 7–10 mm lato, labelli fimbria ad 4 mm longa et callis ordionum distinctorum paribus duobus discretis dispositis differt.

Typus: 3.5 km east of Great Northern Highway on Stephens Rd, 5 km north-east of Bindoon, 31°22'S, 116°09'E, Western Australia, 31 August 1984, S.D. Hopper 3990 (*holo*: PERTH 00274216; *iso*: AD!, CBG!, K!).

Illustrations. W.H. Nicholls, *Orchids of Australia*, plate 247 [*as Caladenia longiclavata*] (1969); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 102, [*as C. longiclavata* var. *magniclavata*] (1984); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 19B, [*as C. longiclavata* var. *magniclavata*] (1984); D. L. Jones, *Native Orchids of Australia*, p. 12 and p. 126 photo on bottom left [*as C. magniclavata*] (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 129 (1992) and rev. 2nd edn with suppl., p. 129 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–30 cm x 6–20 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 12–35 cm tall. *Flowers* 1 or 2(3), c. 3–5 cm across, predominantly red maroon to pale yellow with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal half, then abruptly narrowing for 1–2 mm before expanding to an osmophore; osmophore tumescent, 10–17 mm long on sepals, 5–10 mm long on petals, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 2.5–4 cm x 2–3 mm. *Lateral sepals* straight, spreading obliquely downwards, 2.5–4 cm x 4–5 mm. *Petals* upcurved with a vertical apex, 2–3 cm x 2–3 mm. *Labellum* 3-lobed, prominently 2-coloured, yellowish-green with pink to red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 1–2 mm wide; lamina linear-cordate to cordate with a broadly obtuse apex in outline when flattened, 12–16 x 7–12 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli; lateral lobes erect to obliquely ascending with entire margins near the claw, becoming fimbriate with slender slightly clubbed linear dark maroon calli to 4 mm long which are abruptly decrescent near midlobe; midlobe margins with short slender slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 2 pairs of rows (with a clear gap between them) extending at least 3/4 the length of the labellum, dark maroon, golf stick-shaped, the longest c. 2.5 mm tall, decrescent towards apex and becoming sessile. *Column* 10–15 x 7–9 mm, broadly winged, dark dull maroon with pale yellow blotches. *Anther* c. 2.5 x 2.5 mm, yellow-maroon. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 2.5 mm wide, dark dull maroon. *Capsule* not seen. (Figure 2R–W)

Selected specimens examined. WESTERN AUSTRALIA: Walpole, 34°59'S, 116°43'E, 27 Sep. 1960, *Forests Department s.n.* (PERTH 00282839); Mahogany Creek, 31°54'S, 116°08'E, 16 Aug. 1930,

B.T. Goadby s.n. (PERTH 00275131); 5 km NW of Margaret River, junction of O'Neil Rd and Engine Rd, 33°55'S, 115°05'E, 9 Oct. 1984, *S.D. Hopper* 4289 (PERTH 00792896); Western Boundary Rd, 0.6 km N of Logue Brook turnoff, c. 14 km ENE of Harvey, 32°39'S, 115°59'E, 25 Sep. 1987, *S.D. Hopper* 6109b (PERTH 01698915); Gibson–Esperance Downs Research Station, 33°39'S, 121°49'E, 27 Aug. 1978, *F. Magaganotti s.n.* (PERTH 00283282); 8.5 km S of Witchcliffe on Bussel Highway, 34°06'S, 115°06'E, 30 Aug. 1975, *B.R. Maslin* 3791 (PERTH 00282804); 59 miles [95 km] W of Esperance, 33°43'S, 120°59'E, 12 Aug. 1951, *R.D. Royce* 3636a (PERTH 00282820); *s.loc.*, Sep. 1966, *E.M. Scrymgeour* 1206 (PERTH 00282863); Bridgetown area, 33°58'S, 116°08'E, *s.d.*, *J. Shanks s.n.* (PERTH 00282901); Gibson truck bay area, edge of townsite, 33°39'S, 121°49'E, 27 Aug. 1978, *D.R. Voigt* 89pp (PERTH 00282898).

Distribution and habitat. Occurs in forests from Bindoon south to Augusta and east to Albany, with scattered populations further east to near Esperance in winter-wet flats dominated by low heath. Grows in a range of soils from sand to lateritic loam. (Figure 3D)

Flowering period. August to October.

Etymology. Named from the Latin –*arrectus* (set upright, pointing upwards), alluding to the distinctive upswept petals.

Notes. An uncommon (Priority Four) but wide-ranging species previously confused with *Caladenia longiclavata* and *C. magniclavata*. *C. arrecta* is readily distinguished from these and other members of the *C. longiclavata* complex by its upswept petals and its calli in two pairs of rows with a clear gap between them. Nicholls (1950) provided the first illustration of *C. arrecta*, describing it as a “remarkably robust form” of *C. longiclavata*, but choosing not to name it because he believed its differences were “only a matter of degree”. The easternmost populations of *C. arrecta* between the Fitzgerald River National Park and near Esperance are darker coloured than all others and may have other features that warrant recognition of these plants as a subspecies.

Caladenia attingens* Hopper & A.P. Br., *sp. nov.

A *Caladenia falcata* (Nicholls) M. Clements et Hopper floribus minoribus, labello callisque in apice atro-marronino extenso differt.

Typus: 7 km west-north-west of Margaret River, 8 km south of Gracetown, 33°56'S, 115°00'E, Western Australia, 9 October 1984, *S.D. Hopper* 4239 (*holo:* PERTH 00234338; *iso:* AD!, CBG!, K!).

Plant solitary or in loose clumps. *Leaf* erect, linear, 6–20 cm x 5–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 17–45 cm tall. *Flowers* 1 or 2(3), c. 4–7 cm across, predominantly green to greenish-yellow with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal third, then abruptly narrowing and filiform before terminating in an osmophore; osmophore slightly tumescent, 2–20 mm long on dorsal sepal, 5–20 mm long on lateral sepals, 2–10 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly to prominently incurved, 3.5–7 cm x 2–3 mm. *Lateral sepals* 3.5–6 cm x 3–4 mm, held below horizontal for the first 1–1.5 cm then curving upwards vertically. *Petals* straight, spreading obliquely downwards, 3.5–5 cm x 2–3 mm. *Labellum* prominently 3-lobed, 2-coloured, yellowish-green, terminating in a uniformly dark maroon recurved apex, loosely articulate on a claw c. 2–3 mm wide; lamina hastate with the lateral lobe apices curved forward and the midlobe narrowly triangular and acute in outline when flattened, 12–20 x

15–24 mm, basal third erect, distal 2/3 horizontal except for a shortly recurved apex, margins at widest point deeply curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire proximal margins from the claw to the apex, then abruptly fimbriate comb-like with slender linear yellowish-green calli to 5 mm long which are decrescent (sometimes abruptly) near midlobe; midlobe margins with short slender slightly forward-facing obtuse simple calli decrescent towards the apex. *Lamina calli* in 4 densely congested rows extending at least 3/4 the length of the labellum (onto the dark maroon apex), dark purplish-maroon, golf stick-shaped, the longest c. 4 mm tall, decrescent towards apex and becoming sessile. *Column* 15–20 x 6–8 mm, narrowly winged, wings flat near base, pale yellow-green with pinkish blotches. *Anther* c. 2 x 2 mm, greenish-yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3 mm wide, dark dull maroon to pale green. *Capsule* not seen.

Distribution and habitat. Occurs between Perth and the Balladonia–Israelite Bay area, growing in a range of habitats from low coastal heath, Marri/Jarrah woodlands and dense Karri forest to drier mallee woodlands, salt lake margins and granite outcrops. Soil is usually deep sand or sandy clays. However, plants occasionally may also be found in heavy lateritic loams and shallow granitic soil.

Flowering period. Late September to November.

Etymology. Named from the Latin *atingens* (reaching to, attaining), alluding to the calli which in this species extend onto the dark maroon labellum apex.

Notes. A locally common species with colourful green, yellow and maroon flowers. It is closely related to *Caladenia falcata* but differs in its smaller brightly coloured flowers, its petals always with osmophores, its column lobes flat (not crenulate) near the base, its somewhat smaller labellum with lamina calli extending further out onto the maroon labellum apex. *C. attingens* occasionally hybridizes with *C. longicauda*.

Caladenia attingens has two subspecies, with a zone of intergradation on creeklines between Jerramungup and north-west of Ravensthorpe.

Key to subspecies of *Caladenia attingens*

1. Labellum lamina 18–24 mm wide. Lateral sepals 3–6 mm wide.
Occurs between Jerramungup and Perth. Flowering late September
to November subsp. **atingens**
- 1: Labellum lamina 15–17 mm wide. Lateral sepals 2–3 mm wide.
Occurs between Jerramungup and Israelite Bay. Flowering late August
to early October subsp. **gracillima**

Caladenia attingens* Hopper & A.P. Br. subsp. *atingens

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 117 (1992) and rev. 2nd edn with suppl., p. 117 (1998).

Lateral sepals 3.5–6 cm x 3–6 mm. *Labellum lamina* 14–20 x 18–24 mm. (Figure 4A–D)

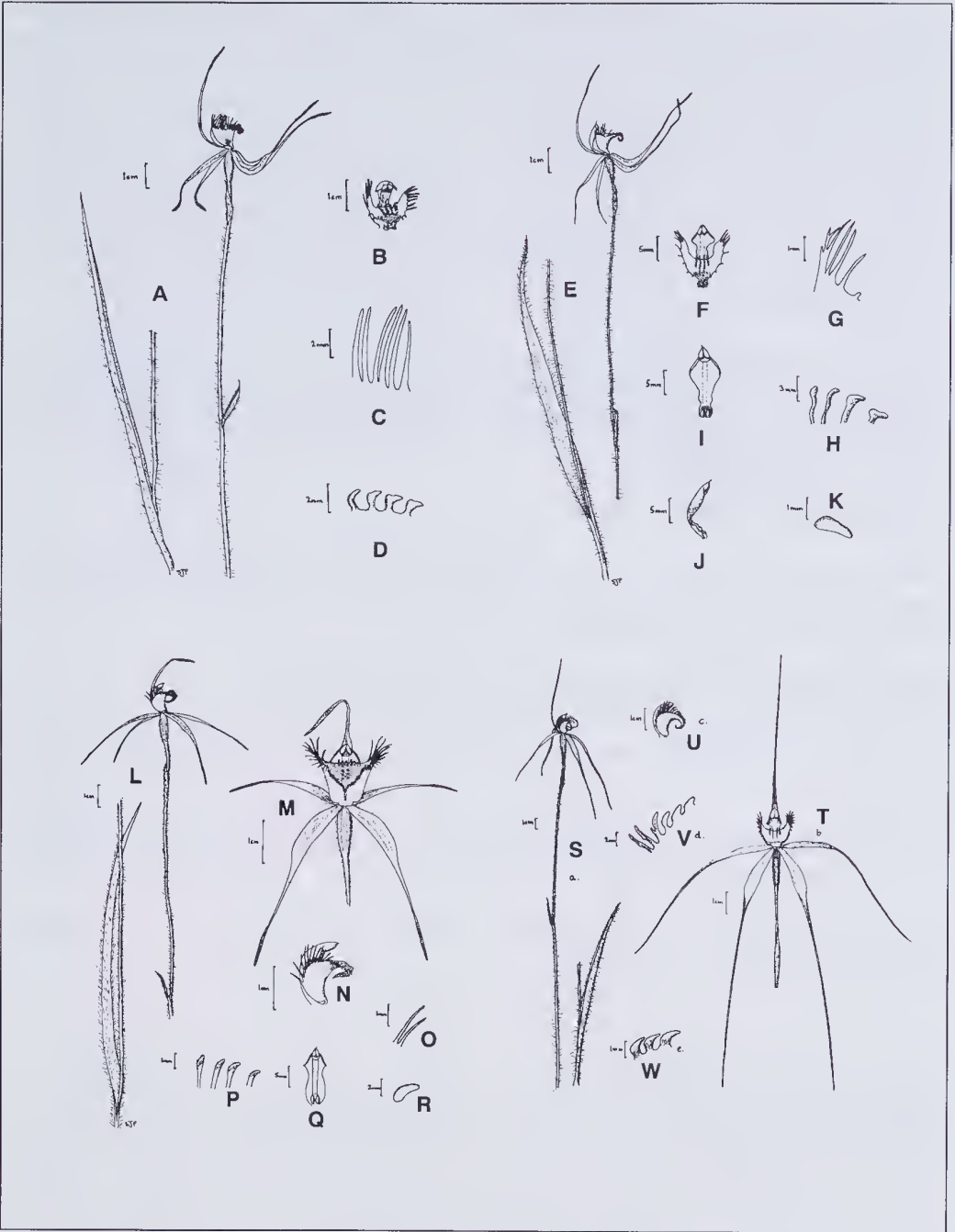


Figure 4. A-D. *Caladenia attingens* subsp. *attingens* from Gracetown area, S.D. Hopper 4293. A - plant; B - labellum and column from front; C - labellum fringe; D - calli. E-K. *C. attingens* subsp. *gracillima* from Peak Charles, A.P. Brown 746. E - plant; F - labellum and column from front; G - labellum fringe; H - calli; I - column from front, J - column from side; K - pollinia. L-R. *C. brownii* from Northcliffe, A.P. Brown 719. L - plant; M - flower; N - labellum and column from front; O - labellum fringe; P - calli; Q - column from front; R - pollinia. S-W. *C. citrina* from Witchcliffe area S.D. Hopper 4286. S - plant; T - flower; U - labellum and column from side; V - labellum fringe; W - calli. Drawn by S.J. Patrick.

Selected specimens examined. WESTERN AUSTRALIA: Bramley Rd, 5 km NNE of Margaret River, 33°55'S, 115°04'E, 15 Oct. 1985, *A. Brown* 254 (PERTH 00905453); 24 km E of Busselton, on Evans Rd at the picnic area, 33°40'S, 115°36'E, 2 Oct. 1983, *D. Cooper* 16 (PERTH 00233420); 9 km E of Northcliffe, off Muirillup Rd, 34°10'S, 116°40'E, 20 Oct. 1984, *G. Gardner s.n.* (PERTH 00233439); Leeuwin–Naturaliste National Park, 4 km SSW of Yallingup, on Caves Rd, 33°41'S, 115°01'E, 5 Oct. 1983, *S.D. Hopper* 3445 (PERTH 00331856); c. 1.5 km S of Brookton Highway along seasonal creekline, 2.6 km E of Warradale Rd, 32°19'S, 116°32'E, 20 Oct. 1987, *S.D. Hopper* 6245 (PERTH 01667467); Nuyts Wilderness Walk Trail, c. 1.5 km S of Tinglewood Rd, 10 km WSW of Walpole, 35°00' S, 116°37' E, 28 Oct. 1987, *S.D. Hopper* 6289 (PERTH 01192507); Deeside Coast Rd, 10 km S of Chesapeake Rd, 34°52'S, 116°15'E, 29 Oct. 1987, *S.D. Hopper* 6297 (PERTH 01711660); Cape Naturaliste, Sugarloaf Rock road, 7 Oct. 1982, *G.J. Keighery* 5293 (PERTH 00235792).

Distribution and habitat. Occurs between Perth and the Jerramungup area, growing in a range of habitats from low coastal heath to Marri/Jarraah woodlands and dense Karri forest. Soil is usually deep sand or sandy clays. However, plants may also occasionally be found in heavy lateritic loams and shallow granitic soil. (Figure 5A)

Flowering period. Late September to November.

Notes. A common subspecies found in large numbers in areas of suitable habitat. It differs from *Caladenia attingens* subsp. *gracillima* in its broader lateral sepals and labellum, westerly range of distribution and later flowering period.

***Caladenia attingens* subsp. *gracillima* Hopper & A.P. Br., subsp. nov.**

A subsp. *attingens* floribus minoribus, distributione geographica plus orientali et florenti plus mature differt.

Typus: Elverdton, south-east of Ravensthorpe, 33°37'S, 120°08'E, Western Australia, 9 September 1971, *A.S. George* 10973b (*holo:* PERTH 00235318).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 118 (1992) and rev. 2nd edn with suppl., p. 118 (1998).

Lateral sepals 3–5.5 cm x 2–3 mm. *Labellum lamina* 12–17 x 15–17 mm. (Figure 4E–K)

Selected specimens examined. WESTERN AUSTRALIA: Ravensthorpe Range, 2 Sep. 1968, *E.M. Bennett* 2534 (PERTH 00235369); Rock Hole Rd near creek, Munglinup, 5 Aug. 1980, *A. Brown s.n.* (PERTH 00331791); Fitzgerald River, between Ravensthorpe and Jerramungup, 8 Sep. 1979, *A. Brown s.n.* (PERTH 00235768); W slope of Mt Ney, 33°24'S, 122°28'E, 7 Aug. 1980, *A.S. George* 15860 (PERTH 00261912); Wittenoom Hills, 47 km NE of Esperance, 33°28'S, 122°08'E, 8 Oct. 1985, *S.D. Hopper* 4685 (PERTH 00908568); c. 17 km NW of Jerramungup, 33°49'S, 118°48' E, 24 Sep. 1988, *S.D. Hopper* 6793 (PERTH 01698443); 9.5 km NE of Hatters Hill, on the Lake Hope track, 32°45' S, 120°02' E, 28 Sep. 1988, *S.D. Hopper* 6869 (PERTH 01698427); 23 km N of Bremer Bay and 5 km NW of W Mt Barren, 34°11'S, 119°24'E, 3 Oct. 90, *S.D. Hopper* 7874 (PERTH 1828894); Peak Charles, 32°53'S, 121°10'E, 8 Sep. 91, *S.D. Hopper* 8161 (PERTH 1829068); Mt Willgonarinya, c. 72 km S of Balladonia Motel, Eyre Highway, 15 Sep. 1980, *K.R. Newbey* 7401 (PERTH 00331813); Mount Ridley, E of Grass Patch, 20 Aug. 1978, *D.R. Voigt* 54pp (PERTH 00233463).

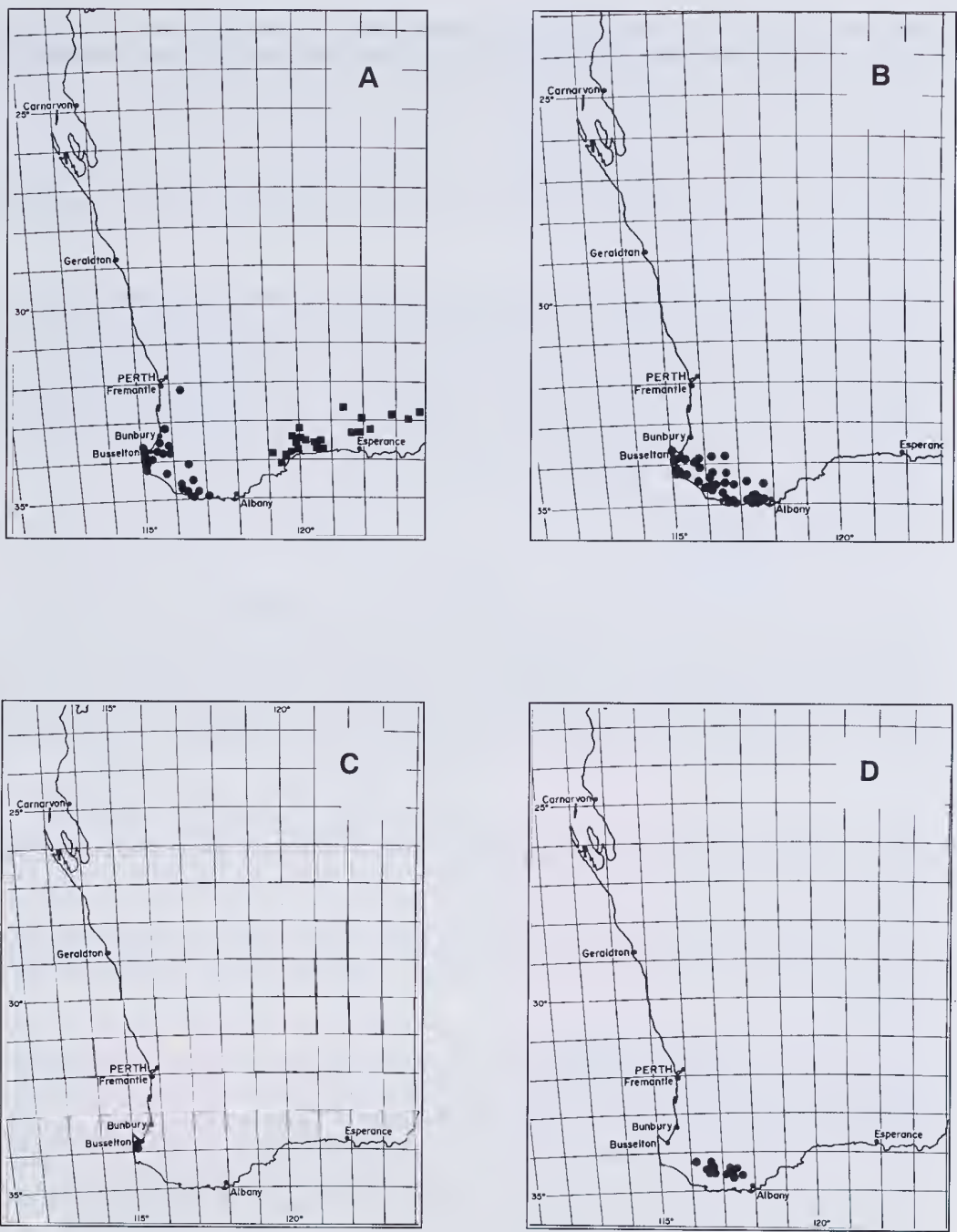


Figure 5. Distribution maps. A – *Caladenia attingens* subsp. *atingens* ● , *C. attingens* subsp. *gracillima* ■ ; B – *C. brownii*; C – *C. busselliana*; D – *C. christineae*.

Distribution and habitat. Grows between Jerramungup and Balladonia-Israelite Bay, in moist situations under scattered mallee eucalypts and dense shrub thickets adjacent to water courses, granite outcrops, and salt lake margins. Soils are sandy-clays or granitic-loams. (Figure 5A)

Flowering period. August to early October.

Etymology. Named from the Latin *gracilis* (thin, slender), alluding to the more slender labellum and lateral sepals of this subspecies.

Notes. A common and widespread subspecies often found in large numbers in areas of suitable habitat. It differs from *Caladenia attingens* subsp. *atingens* in its generally smaller flowers, its narrower labellum and lateral sepals, and its more easterly distribution between Jerramungup and Israelite Bay. The distribution of *C. attingens* subsp. *gracillima* overlaps that of *C. attingens* subsp. *atingens* in the Jerramungup to north-west of Ravensthorpe area, where intergrading populations along watercourses have been found (e.g. *S.D. Hopper* 6824, 6830). However, these two subspecies remain distinct throughout most of their wide geographical ranges.

Caladenia brownii* Hopper, *sp. nov.

A speciebus ceteris gregis *Caladenia huegelii* H. G. Reichb. petalis sepalisque rigidis variabilibus suffusionibus atro-marroninis super abscedente diluto-viride, sepalis lateralibus 3.5–6.5 cm longis et 3.5–5 mm latis, plerumque descentibus cum clavis diluto-vel atro-brunneis 7–25 mm longis, petalis patentibus ad aliquantum recurvatus, declinatis, 3–5 cm longis et 2–4 mm latis cum clavis 4–17 mm longis, labello 15–27 mm longo et 11–16 mm lato, lamina basali diluto-viride cum lineis radiantibus marroninis prominentibus ad inconspicuis, labelli fimbria segmentis gracilibus acutis marroninis compositis, plerumque ad apicem albis, ad 10 mm longis differt.

Typus: Creek Rd, c. 400 m west-south-west of Hilltop Rd, north-east of Walpole, 34°57'S, 116°46'E, Western Australia, 28 October 1987, *S.D. Hopper* 6283 (*holo:* PERTH 01751638; *iso:* AD!, CBG!, K!, MEL!).

Illustrations. M. Pocock, Ground Orchids of Australia, photo 33, [as *C. pectinata*] (1972); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 108 (1992) and rev. 2nd edn with suppl., p. 108 (1998).

Plant solitary or in loose clumps. *Leaf* 10–25 cm x 5–10 mm, linear, erect, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1 or 2(3), c. 4–8 cm across, with variable dark maroon suffusions on a greenish-yellow background; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 7–25 mm long on sepals, 4–17 mm long on petals, light to dark brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–6.5 cm x 2.5–3 mm. *Lateral sepals* spreading and downcurved, 3.5–6.5 cm x 3–6 mm. *Petals* upcurved, horizontal or somewhat downcurved, 3–5 cm x 2–4 mm. *Labellum* 3-lobed (sometimes obscurely), prominently 2-coloured, greenish-yellow with pink to red radiating stripes and suffusions, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw 2–3 mm wide; lamina linear-cordate to cordate in outline when flattened, 15–27 x 11–16 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third horizontal and sharply recurved apically, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes obliquely ascending to erect with entire margins near the claw, becoming fimbriate with

slender filiform dark maroon white-tipped acute calli to 10 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad (occasionally slender) forward-facing obtuse to acute calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least two-thirds the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 15–20 x 7–10 mm, broadly winged, creamy yellow with maroon blotches. *Anther* c. 4 x 4 mm, yellowish-green with maroon suffusions. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3–4 mm wide, yellow-green. *Capsule* not seen. (Figure 4L–R)

Selected specimens examined. WESTERN AUSTRALIA: Chesapeake Rd, SE of Northcliffe, 34°44'S, 116°08'E, 16 Oct. 1985, A. Brown s.n. (PERTH 00930156); Youngs Siding, 17 Oct. 1971, L. Byrne 27 (PERTH 00254878); 2 km NW of Balingup, E side of South West Highway, opposite Balingup Cemetery, 33°59'S, 115°47'E, 16 Oct. 1984, G. Gardner s.n. (CBG, PERTH 00254460); E side of Frankland River, Muir Highway, 34°29'S, 116°54'E, 2 Nov. 1977, A.S. George 15013 (PERTH 00253960); road to Camfield, Broke Inlet, 34°53'S, 116°30'E, 12 Oct. 1969, A.S. George 9719 (PERTH 00254371); 8 km NW of Augusta, Leeuwin–Naturaliste National Park, Jewel Cave turnoff, 34°16'S, 115°06'E, 4 Oct. 1983, S.D. Hopper 3435 (AD, CBG, K, PERTH 00254401); Porongorup road, c. 9.6 km E of Mount Barker, 3.5 km E of Bevan Rd, 34°38'S, 117°46'E, 7 Oct. 1987, S.D. Hopper 6211 (PERTH 01711032); Bow River, Nov. 1912, S.W. Jackson s.n. (PERTH 00253944); Lake William, West Cape Howe, 25 km W of Albany, 6 Dec. 1986, G.J. Keighery 8697 (PERTH 00873128); Deep River, 2 Nov. 1974, T.G. Wilson s.n. (PERTH 00253952).

Distribution and habitat. Occurs in Karri and southern Jarrah forests, in *Banksia/Allocasuarina* low woodlands, in scrub and coastal heath from the Leeuwin–Naturaliste Ridge east to Mount Barker and Albany. Occupies a range of soils from sand to granitic and lateritic loam. (Figure 5B)

Flowering period. October to early December.

Etymology. Named after Mr Andrew P. Brown (1951–), Botanist in CALM's Western Australian Threatened Species and Communities Unit, author of Common Orchids of South-west Australia and co-author of Western Australia's Threatened Flora, Orchids of South-West Australia and of the present paper, in recognition of his outstanding contribution to knowledge and the conservation of Western Australian orchids.

Notes. A common widespread species throughout the higher rainfall forested districts of the lower south-west. Grows with several other members of the *Caladenia huegelii* complex, including *C. ferruginea*, *C. pectinata*, *C. huegelii*, *C. applanata*, *C. viridescens*, *C. paludosa*, *C. infundibularis* and *C. heberleana*. *C. brownii* is readily distinguished from all of these by its petals with thickened osmophores and its later flowering season.

***Caladenia busselliana* Hopper & A.P. Br., sp. nov.**

A *Caladenia viridescens* Hopper et A.P. Br. floribus dilutoribus luteis, labello plus ovato apice luteo (non atro-marronino), in sepalis clavis longioribus differt.

Typus: near Quindalup, Western Australia, 20 October 1990, G. Bussell s.n. (*holo:* PERTH 02648733; *iso:* AD!, CBG!, K!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 102 (1992) and rev. 2nd edn with suppl., p. 102 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 114 (1998).

Plant solitary or in loose clumps. *Leaf* 10–20 cm x 5–10 mm, linear, erect, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–30 cm tall. *Flowers* 1 or 2(3), c. 5–8 cm across, creamy-yellow with occasional suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore narrowly tumescent, 10–20 mm long on sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3–4.5 cm x 3–4 mm. *Lateral sepals* spreading and downcurved, 5–5.5 cm x 4–5 mm. *Petals* horizontal to somewhat downcurved, 3–4.5 cm x 3–4 mm. *Labellum* 3-lobed (sometimes obscurely), uniformly coloured or occasionally suffused pink, with pink to red radiating stripes, stiffly articulate on a claw c. 2 mm wide; lamina cordate in outline when flattened, 15–20 x 10–12 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point curved upwards and terminated by obliquely ascending calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender clubbed narrowly fusiform dark maroon to pink (sometimes white-tipped) calli to 6 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3 the length of the labellum, pink, sometimes white at base, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 15–18 x 6–8 mm, broadly winged, creamy yellow with pink blotches. *Anther* c. 2.5 x 2.5 mm, pale yellowish pink. *Pollinia* c. 2 mm long, flat, yellow. *Stigma* c. 3 mm wide, yellow-green. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: W of Capel, 10 Oct. 91, *S.D. Hopper* 8210 (PERTH 1829351); Vasse/Yallingup area, 11 Oct. 91, *S.D. Hopper* 8213 (PERTH); Flower Show, Sep. 1954, *R.D. Royce* 4849 (CBG, PERTH 00260959).

Distribution and habitat. Poorly known. Apparently confined to two sites at the northern end of the Leeuwin–Naturaliste Ridge and another location further north near Capel. Southern populations grow in winter-wet swamps and acidic grey sandy loam beneath Marri with *Anigozanthos viridis* and *Caladenia paludosa*. Near Capel, the single plant seen was with dense weedy herbs and *C. lorea*, *C. flava*, *C. latifolia* and *Diuris* aff. *amplissima* in Tuart woodland with a Peppermint understorey. Soils there were calcareous grey sandy loam with scattered limestone rock. Flowers best after summer fire. (Figure 5C)

Flowering period. Late September to October.

Etymology. Named after Mr Greg Bussell (1945–), a descendent of the pioneering family after whom Busselton was named, and a keen orchid enthusiast who discovered and made the first collections of this rare species. Greg and his wife Mary have greatly assisted our research, particularly on orchids of the Leeuwin–Naturaliste Ridge where they have farmed and more recently become chalet owners.

Notes. *Caladenia busselliana* is a recently recognized and very rare orchid (Declared Rare) first collected from an unknown location for a flower show in 1954. The species subsequently escaped detection by orchid enthusiasts until 1990. It is one of only three members of the *C. huegelii* complex

in Western Australia known to us that lack a red apex to the labellum. Of the other two, *C. busselliana* differs from *C. interjacens* in having smaller less robust flowers that are creamy-yellow, and shorter narrower osmophores. From *C. lodgeana*, *C. busselliana* differs in its petals lacking osmophores, its smaller creamy-yellow flowers, and earlier (September to October) flowering season.

Caladenia busselliana has flowers also similar to *C. viridescens*, but differs in its paler yellow colouration, the labellum more ovate with a yellow, not dark maroon, apex, its longer osmophores on the sepals, and its preference for winter-wet swamps rather than the dry slopes and woodlands occupied by *C. viridescens*. However, the two species do occur in close sympatry at the type locality of *C. busselliana*, together with *C. paludosa*, *C. chapmanii*, and *C. ferruginea*.

***Caladenia christineae* Hopper & A.P. Br., sp. nov.**

A speciebus aliis *Caladenia longicauda* Lindl. affinibus floribus parvis tepalis rigide tenentibus et labello regulariter curvato margine breve differt.

Typus: west-north-west of Rocky Gully, Western Australia, 16 October 1986, S.D. Hopper 5751 (*holo*: PERTH 01751603; *iso*: AD!, CBG!, K!).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora plate 57 (1990) [as *Caladenia* sp. (Muir)]; N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 71 (1992) and rev. 2nd edn with suppl., p. 71 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 132 (1998).

Plant solitary, rarely in loose clumps. *Leaf* erect, linear, 8–20 cm x 4–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–40 cm tall. *Flowers* 1–4, usually 2 or 3, c. 6–8 cm across, white with occasional faint suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, 4–6 cm x 2–4 mm. *Lateral sepals* spreading and obliquely downcurved, 4–6.5 cm x 4–5 mm. *Petals* horizontal basally, then somewhat downcurved, 3–5 cm x 2.5–3 mm. *Labellum* obscurely 3-lobed, uniformly coloured or occasionally suffused pink, with pink to red radiating stripes, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-cordate in outline when flattened, 15–18 x 7–10 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform dark maroon to pink white-tipped calli to 4 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, pink, becoming white apically, bases white, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 12–15 x 6–8 mm, winged, creamy yellow with pink blotches. *Anther* c. 3 x 3 mm, pale greenish yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide, yellow-green. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: W of Mount Barker, 3 Oct. 1984, R. Bates 4344 (PERTH 00578355); E of Manjimup, 27 Sep. 1983, A. Brown 47 (PERTH 00262374); Muirs highway, 16 Oct. 1986, A. Brown 490 (PERTH 00928682); Lake Muir, 2 Nov. 1977, A.S. George 15031 (CBG, PERTH 00290467); SW of Cranbrook, 1 Oct. 1983, S.D. Hopper 3413 (PERTH 00231568);

WNW of Rocky Gully, 3 Oct. 1983, *S.D. Hopper* 3415 (AD, CBG, K, PERTH 00260347); W of Mount Barker, 8 Oct. 1983, *S.D. Hopper* 3512 (PERTH 00260304); W of Mount Barker, 8 Oct. 1983, *S.D. Hopper* 3521 (PERTH 00260290); Lake Muir, 26 Oct. 1987, *S.D. Hopper* 6266 (PERTH 01443496); W of Mount Barker, 4 Nov. 1986, *G.J. Keighery* 8453 (PERTH 00786861).

Distribution and habitat. Confined to the Mount Barker–Manjimup area where it grows around the margins of winter-wet flats and fresh-water lakes in Jarrah/Marri forests with *Xanthorrhoea* prominent in the understorey, or in *Melaleuca cuticularis* low forest and woodland. Soils are sandy loams. Flowers in greatest abundance after fire. (Figure 5D)

Flowering period. Late September to October.

Etymology. Named after Christine G. Hopper, wife of the senior author and school teacher, who has assisted our research in many ways.

Notes. *Caladenia christineae* is declared as Rare Flora (Brown *et al.* 1998). The species is one of the smallest-flowered members of the *C. longicauda* complex, and differs from most in its short labellum fringe, and stiffly held relatively short sepals and petals.

Caladenia christineae grows with, and flowers at the same time as, *C. longicauda*, but does not appear to hybridize with it. *C. christineae* has been collected once at the same site as *C. harringtoniae*. It also grows with, but flowers a month earlier than, *C. pholcoidea* and *C. serotina*. From *C. pholcoidea*, *C. christineae* differs in its white colouration, shorter, more stiffly held petals and sepals, and earlier flowering season.

Of other members of the complex growing in similar forest habitat, only *Caladenia uliginosa* could be confused with this species. *C. christineae* differs from *C. uliginosa* in its taller scapes, its flowers with no apparent odour, and its more evenly recurved, somewhat shorter labellum.

There are small-flowered members of the *Caladenia patersonii* complex in South Australia that resemble *C. christineae* in the size of their flowers and their short labellum fringe (e.g. *R. Bates* 20217a PERTH), but these populations differ in their shorter 1- or 2-flowered scapes, darker more glandular sepals and petals, their shorter broader labellum, and thicker clubbed labellum fringe segments. We have no data on how the tepals of these plants are held when fresh, nor on floral odour.

Caladenia citrina Hopper & A.P. Br., *sp. nov.*

A speciebus aliis *Caladenia longicauda* Lindl. affinibus floribus tepalis rigide tenentibus pallido-citrinis, sepalis lateralibus 6–9 cm longis 5–7 mm latis et fimbria marginali labelli ad 3–5 cm longa differt.

Typus: 1.1 km south of Witchcliffe on Bussel Highway, at junction with Davis Rd, 34°02'S, 115°06'E, Western Australia, 4 October 1983, *S.D. Hopper* 3417 (*holo:* PERTH 00255823; *iso:* AD!, CBG!, K!, MEL!, NSW!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 66, [as *Caladenia* sp.] (1984), 2nd edn, p. 88 (1992) and rev. 2nd edn with suppl., p. 88 (1998).

Plant solitary. *Leaf* erect, linear, 10–25 cm x 5–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–45 cm tall. *Flowers* 1 or 2(3), c. 6–9 cm across, pale lemon-yellow except for maroon markings on calli; floral odour faintly acrid. *Sepals and petals* stiffly held, linear-lanceolate in basal quarter, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, 6.5–9 cm x 3–4 mm. *Lateral sepals* spreading and obliquely downcurved, 6–9 cm x 5–7 mm. *Petals* 5–7.5 cm x 3–5 mm, horizontal basally, then somewhat downcurved. *Labellum* obscurely 3-lobed, uniformly coloured or occasionally suffused pink, with pale maroon radiating stripes, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate to cordate in outline when flattened, 18–23 x 10–14 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform pale maroon white-tipped calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, pale maroon, becoming lemon yellow apically, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 16–18 x 8–10 mm, winged, lemon yellow with fawn blotches. *Anther* c. 3–4 x 3–4 mm, lemon yellow with green suffusions. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3–4 mm wide, yellow-green. *Capsule* not seen. (Figure 4S–W)

Selected specimens examined. WESTERN AUSTRALIA: S of Yallingup, 8 Oct. 1967, A.S. George 9204 (CBG, PERTH 00255386); 1.1 km S of Witchcliffe on Bussell Highway, at junction with Davis Rd, 34°02'S, 115°06'E, 4 Oct. 1983, S.D. Hopper 3418 (PERTH 00255408); 8 km E of Margaret River, 12.5 km SE of Cowaramup, Rosa Brook Rd, 33°57'S, 115°10'E, 4 Oct. 1983, S.D. Hopper 3422 (PERTH 00255424); 5 km NW of Margaret River, junction of O'Neil Rd and Engine Rd, 33°55'S, 115°05'E, 9 Oct. 1984, S.D. Hopper 4286 (PERTH 00255416); Cowaramup road, c. 500 m W of Caves Rd on S side, 33°52'S, 115°00'E, 30 Sep. 1986, S.D. Hopper 5582 (PERTH 00874604); Flower Show, Sep. 1954, R.D. Royce 4849b (PERTH 01669117).

Distribution and habitat. Confined to Jarrah/Marri forests on gravelly or granitic loam soils of the Leeuwin–Naturaliste Ridge between Dunsborough and Forest Grove, extending inland to the east of Margaret River. (Figure 6A)

Flowering period. Late September to October.

Etymology. Named from the Latin – *citrinus* (lemon yellow), alluding to the floral colour.

Notes. *Caladenia citrina* is a distinctive, attractive and unusually-coloured member of the *C. longicauda* complex. It occurs over a narrow geographical range but is reasonably abundant. We have found *C. citrina* and *C. longicauda* growing together at only one location (on Caves Rd north of the Gracetown turn off). The two species otherwise appear to be allopatric. *C. citrina* differs from *C. longicauda* in its pale lemon-yellow floral colour and its labellum with shorter marginal calli. There appear to be no close relatives of *C. citrina* in the *C. longicauda* complex. Its labellum fringe is relatively short with apical clubs on the segments, suggesting a distant relationship to eastern members of the *C. patersonii* complex.

***Caladenia cruscula* Hopper & A.P. Br., sp. nov.**

A *Caladenia longicauda* Lindl. petalis sepalisque multis brevioribus et fimbria brevioribus labelli differt.

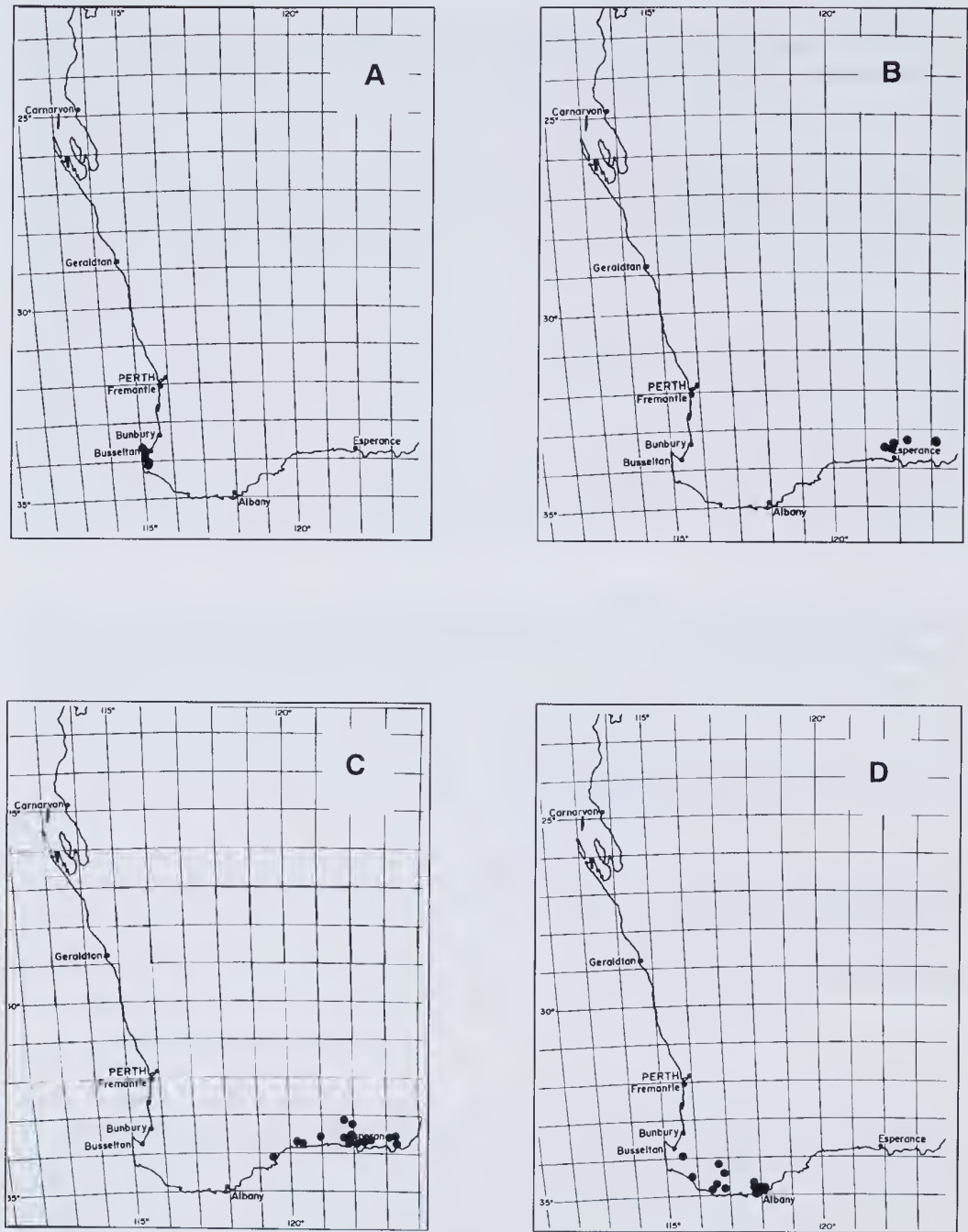


Figure 6. Distribution maps. A – *Caladenia citrina*; B – *C. cruscula*; C – *C. decora*; D – *C. ensata*.

Typus: near salt lake, Kau Nature Reserve 33°28'S, 122°21'E, Western Australia, 10 August 1980, A.S. George 15939 (*holo*: PERTH 00277576).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 69 (1992) and rev. 2nd edn with suppl., p. 69 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 8–13 cm x 4–6 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 18–25 cm tall. *Flowers* 1 or 2, c. 4–5 cm across, cream to white with maroon markings and suffusions; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, 3.5–4 cm x 2–2.5 mm. *Lateral sepals* spreading and obliquely downcurved, 3–5 cm x 3–5 mm. *Petals* spreading obliquely downwards, 3.5–4 cm x 2–2.5 mm. *Labellum* obscurely 3-lobed, uniformly coloured except for maroon calli, stiffly articulate on a claw c. 1.5 mm wide; lamina cordate in outline when flattened, 12–15 x 7–11 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli; lateral lobes erect with entire margins within 3 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform pale maroon white-tipped calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, pale maroon, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 12–15 x 5–7 mm, broadly winged, greenish yellow with red suffusions and blotches. *Anther* c. 2.5 x 2.5 mm, brownish yellow with green suffusions. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 2.5–3 mm wide, yellow-green. *Capsule* not seen. (Figure 7)

Selected specimens examined. WESTERN AUSTRALIA: Truslove Nature Reserve, 9.8 km N of Scadden on the Coolgardie–Esperance highway, 33°30'S, 121°45'E, 12 Sep. 91, S.D. Hopper 8190 (PERTH 1829238); 19 km NE of Scadden on Truslove Rd, 10 Sep. 1983, P. van der Moezel PGV284 (PERTH 00231185); Scadden Rd, E of Esperance–Norseman road, 16 Sep. 1988, A.J.G. Wilson 154 (PERTH 00900079).

Distribution and habitat. Apparently confined to clay loam beside a few salt lakes north of Esperance where it grows in low heath or open *Melaleuca* and mallee scrub on fresh-water seepages. Associated mallees include *Eucalyptus conglobata*, *E. tumida*, *E. leptocalyx*, *E. spathulata* subsp. *grandiflora* and *E. aff. flocktoniae*. The species has also been found in Swamp Yate flats growing with *Caladenia brevisura*, *C. attingens* subsp. *gracillima* and *C. longicauda* subsp. *rigidula*. (Figure 6B)

Flowering period. Late August to early October.

Etymology. Named from the latin *cruscula* (small-legged), alluding to the relatively short sepals and petals for a species in the *Caladenia longicauda* complex.

Notes. *Caladenia cruscula* is a poorly known and apparently rare species readily distinguished from other members of the *C. longicauda* complex by its very short stiffly downcurved petals and sepals, and its small labellum with short marginal calli. *C. longicauda* subsp. *rigidula* also grows north of Esperance, but differs in its flowers being usually larger with longer petals and sepals and a longer labellum (rare uppermost flowers of multiflowered scapes of *C. longicauda* subsp. *rigidula* may be smaller and overlap in dimensions with those of *C. cruscula*). Thynnid wasps were attracted to bait flowers of *C. cruscula* at Clyde Hill, and may pollinate the species (A.P. Brown, unpubl.).

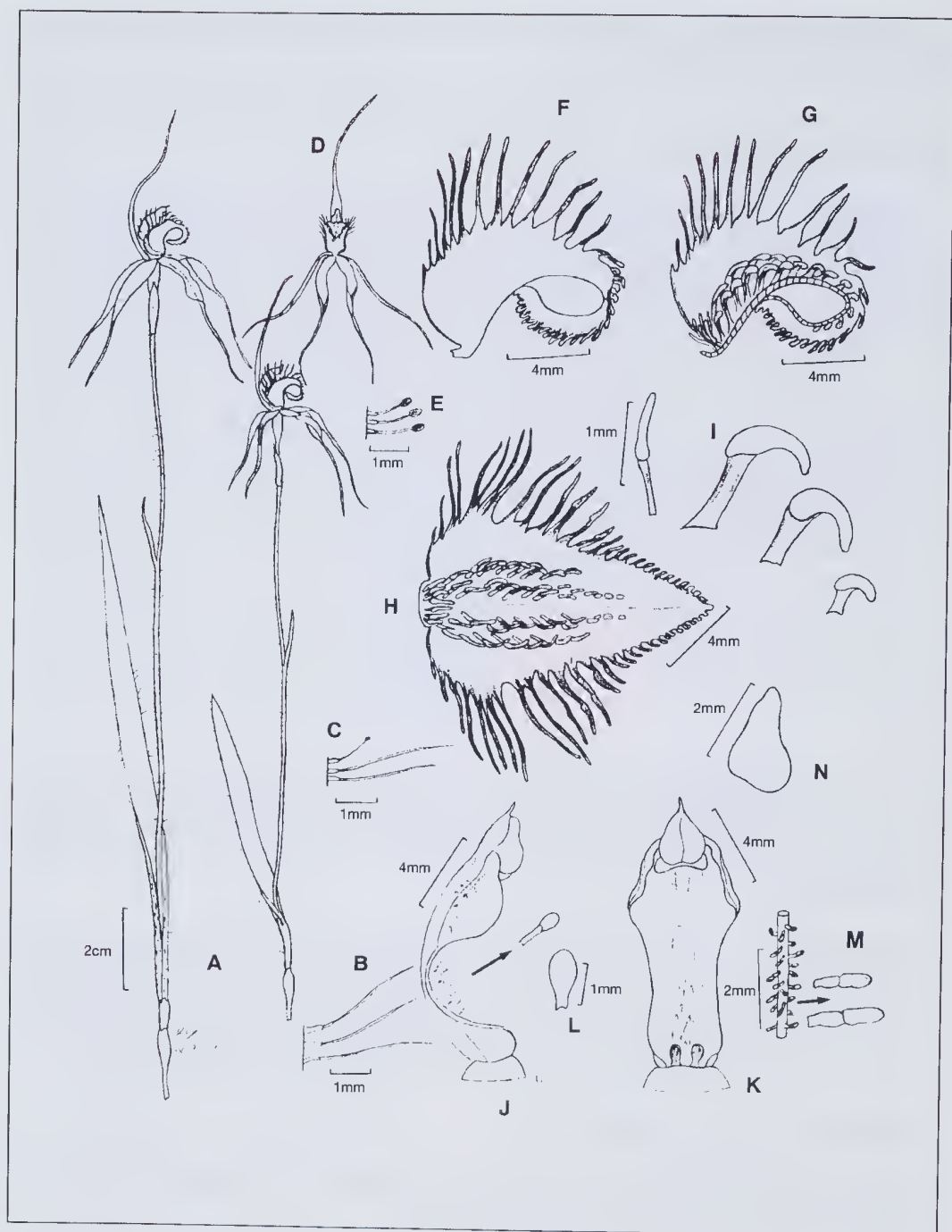


Figure 7. *Caladenia cruscula* from Truslove, S.D. Hopper 8190. A – plants; B – hairs from lower scape; C – hairs from upper scape; D – flower; E – glandular hairs from sepals; F – labellum from side; G – sectioned labellum from side; H – flattened labellum from above; I – calli; J – column from side; K – column from front; L – hair from inside of column; M – hair from outside of column; N – pollinia. Drawn by D.L. Jones.

The short labellum fringe, small stiffly held flowers and easterly distribution in south-western Australia of *Caladenia cruscula* align this species to some eastern Australian members of the *C. patersonii* complex.

***Caladenia decora* Hopper & A.P. Br., sp. nov.**

A speciebus aliis *Caladenia huegelii* H.G. Reichb. affinibus petalis sepalisque atrorubris vel marroninis, saepe clavis robustis pallido-testaceis in petalis sepalisque differt.

Typus: Jerdacuttup River ford on Springdale Rd, 33°53'S, 120°14'E, Western Australia, 29 September 1987, S.D. Hopper 6146 (*holo*: PERTH 01706950).

Illustrations. D. Jones, Native Orchids of Australia, p. 130 top left (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 110, [*as C. huegelii*] (1984), 2nd edn, p. 110 (1992) and rev. 2nd edn with suppl., p. 110 (1998).

Plant solitary or in small clumps. *Leaf* 9–22 cm x 6–10 mm, linear, erect, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–50 cm tall. *Flowers* 1–3, c. 5–10 cm across, predominantly red maroon to pale yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 12–25 mm long on dorsal sepal, 12–25 mm long on lateral sepals, 10–22 mm long (occasionally absent) on petals, yellow-brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4.5–7 cm x 3–6 mm. *Lateral sepals* spreading and downcurved, 5–8 cm x 3.5–8 mm. *Petals* slightly ascending to somewhat downcurved, 4–6 cm x 3.5–5 mm. *Labellum* 3-lobed (sometimes obscurely), prominently 2-coloured, dark pink to white with pink to red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2.5 mm wide; lamina linear-cordate in outline when flattened, 20–28 x 13–20 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear occasionally bifurcate dark maroon (sometimes white-tipped) calli to 9 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 18–28 x 9–12 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 3–4 x 3–4 mm, dark maroon to yellow. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 3–4 mm wide, dark yellow-green to red. *Capsule* not seen. (Figure 8A–E)

Selected specimens examined. WESTERN AUSTRALIA: S side of Boyatup Hill, 33°44'S, 123°02'E, 13 Aug. 1980, A.S. George 15979 (PERTH 00307939); granite hill behind Wharton Beach, 0.5 mile [0.8 km] inland, Duke of Orleans Bay, Cape Le Grand National Park, 1 Sep. 1977, A.J. Harrington s.n. (PERTH 00233501); Lort River, 4 Oct. 1980, R. Heberle s.n. (PERTH 00233064); Jerdacuttup River ford on Springdale Rd, 33°53'S, 120°14'E, 29 Sep. 1987, S.D. Hopper 6146 (PERTH 01706950); slopes of Mt Baring, Cape Arid National Park, 33°43'S, 123°15'E, 11 Sep. 1991, S.D. Hopper 8177 (PERTH 1829114); Fitzgerald River National Park, base of West Mt Barren, 20 Sep. 1969, K.R. Newbey 2898 (PERTH 00238767); Shark Lake area, Esperance, 24 Sep. 1971, V. Scarth-Johnson 811a (CANB, PERTH 00561169); Condingup Rd junction, at 570 mile [peg] Coolgardie–Esperance Highway, Sep. 1966, E.M. Scrymgeour 834 (PERTH 00233110); Flora and Fauna Reserve Number 32128, 5 Sep. 1978,

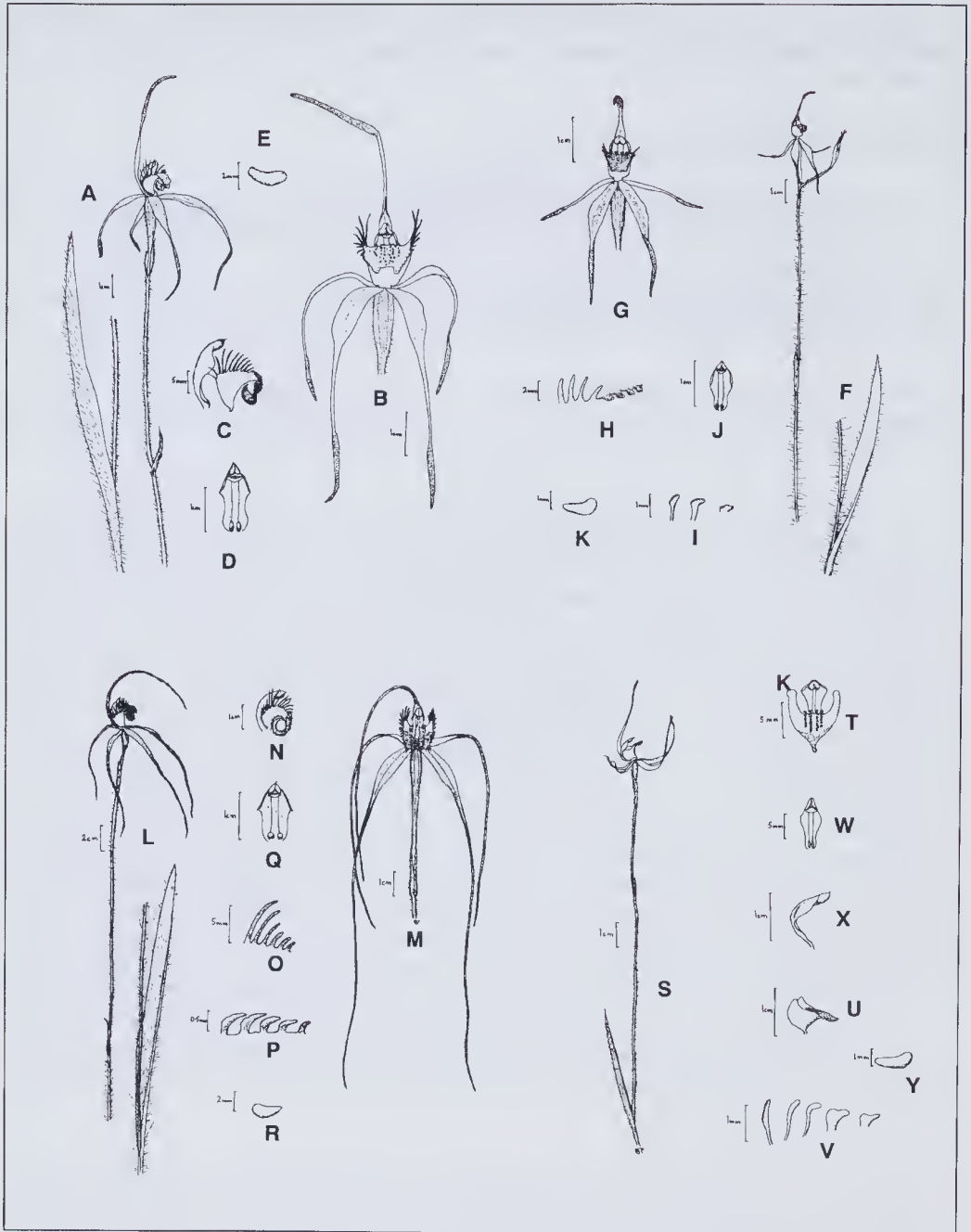


Figure 8 A-E. *Caladenia decora* from north of Esperance, S.D. Hopper 4698. A - plant; B - flower; C - labellum and column from side; D - column from front; E - pollinia. F-K. *C. ensata* from west of Northcliffe, A.P. Brown 741. F - plant; G - flower; H - labellum margin; I - calli; J - column from front; K - pollinia. L-R. *C. excelsa* from the Leeuwin-Naturaliste area, S.D. Hopper 4294. L - plant; M - flower; N - labellum and column from side; O - labellum fringe; P - calli; Q - column from front; R - pollinia. S-Y. *C. exstans*. S - plant; T - labellum and column from front; U - labellum from side; V - calli; W - column from front; X - column from side; Y - pollinia. Drawn by S.J. Patrick.

D.R. Voigt 60 pp (PERTH 00233021).

Distribution and habitat. Ranges from Fitzgerald River National Park eastwards to Cape Arid National Park along the south coast, as far inland as Scadden. Grows in winter-wet flats and swamps or run off areas on granite outcrops or along creeklines, usually in dense low heath in sandy clay-loams. (Figure 6C)

Flowering period. August to October.

Etymology. Named from the Latin – *decora* (painted) alluding to the rich floral colouration compared with that of *C. pectinata*.

Notes. A locally common species well represented in national parks and nature reserves. Western populations of *Caladenia decora* have consistently short stiff petals held above the horizontal while those found to the east of Esperance occasionally have long drooping petals. This may be due to hybridisation with *C. heberleana*.

Caladenia decora is related to *C. pectinata*, differing in its larger more richly coloured flowers, petals longer and usually with osmophores, and the sepals with longer osmophores that are often channelled in their upper half. These two species grow together in the Ravensthorpe–Fitzgerald River National Park area. *C. decora* also overlaps with *C. heberleana* throughout its range, but *C. decora* differs in its darker floral colouration, its shorter petals which may lack osmophores, its more robust paler sepaline osmophores, and its larger labellum with a uniformly dark maroon marginal calli.

Caladenia decora differs from *C. procera* in its predominantly red maroon to pale yellow flowers with variable suffusions, lines and spots of dull maroon to pink, and its somewhat shorter scapes. *C. decora* also differs from *C. procera* in its petals slightly ascending to somewhat downcurved, usually with osmophores, and its narrower more obtuse column wings. *C. decora* hybridizes with *C. longicauda* subsp. *crassa* at several places near Esperance.

Caladenia ensata Nicholls, *Victorian Naturalist* 64: 138, f. (1947). *Type:* abundant in very heavy scrub, King River, adjacent to Balleymena Guest House and along granite slopes westward 1.5 miles [3 km], Western Australia, October 1946, *W.H. Nicholls s.n. (holo: MEL!)*.

Illustrations. W. Nicholls, *Orchids of Australia*, plate 245 (1969); D. Clyne, *Australian Ground Orchids*, p. 35 plate 39, [as *Caladenia longiclavata*] (1970); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 63 (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 126 (1992) and rev. 2nd edn with suppl., p. 126 (1998).

Plant solitary or rarely in loose clumps. *Leaf* erect, linear, 7–14 cm x 10–20 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1 or 2(3), c. 3–5 cm across, predominantly red maroon to pale yellow with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal half, then abruptly narrowing for 1–2 mm before expanding to an osmophore; osmophore tumescent, 5–12 mm long on dorsal sepal, 8–12 mm long on lateral sepals, 2–10 mm long on petals, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 2.5–3.5 cm x 2–3 mm. *Lateral sepals* straight, spreading obliquely downwards, 2.2–3.5 cm x 3–4 mm. *Petals* spreading obliquely downwards, 2–3 cm x 1.5–2.5 mm. *Labellum* obscurely 3-lobed, prominently

2-coloured, yellowish-green with pale pink to pale red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-cordate to cordate with an acute apex in outline when flattened, 12–14 x 8–10 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point flattened and terminated by slightly ascending calli; lateral lobes erect to obliquely ascending with entire margins near the claw, becoming dentate with slender to broad simple linear yellow-green calli to 1(2) mm long which are slightly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* in 4 dense rows (lacking clear gaps between them) extending at least 3/4 the length of the labellum, dark maroon, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 12–15 x 6–8 mm, broadly winged, dull yellow-maroon. *Anther* c. 2.0–2.5 x 2.0–2.5 mm, yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5–3 mm wide, dull yellow maroon. *Capsule* not seen. (Figure 8F–K)

Selected specimens examined. WESTERN AUSTRALIA: Gull Rock, E of Albany, 17 Oct. 1971, L. Byrne 31 (PERTH 00274259); Broke Inlet near Camfield townsite, 12 Oct. 1969, A.S. George 9723 (PERTH 00848808); 9 km WSW of Mt Roe, 35.6 km S of Muirs Highway on Thomson Rd, 34°44'S, 116°42'E, 8 Oct. 1983, S.D. Hopper 3537 (PERTH 00282421); 4.4 km S of Old Vasse Rd on Ritter Rd, 15 km SW of Pemberton, 34°30'S, 115°56'E, 8 Oct. 1984, S.D. Hopper 4266 (PERTH 00792829); area off Muir Highway, c. 400 m W of Frankland River and c. 250 m N of Muir Highway, 34°28'S, 116°53'E, 2 Nov. 1990, W. Jackson BJ184 (PERTH 01700057); near Nigger Head Rock, Torndirrup, 18 km S of Albany, 3 Oct. 1986, G.J. Keighery 9620 (PERTH 00873012); Porongurup Range, Oct. 1929, B. Truscott s.n. (PERTH 00273775).

Distribution and habitat. Occurs in *Banksia* or Jarrah woodland, in deep sandy soils, between Albany and Nannup. (Figure 6D)

Flowering period. September to November.

Notes. George (1971) synonymized this species under *Caladenia longiclavata* var. *longiclavata* without comment. Jones (1988) reinstated the species, and noted that "*C. ensata* is closely related to *C. longiclavata* but can be distinguished by the short, widely spaced segments on the labellum margins and the crowded calli." The latter suggestion that crowded calli are diagnostic of *C. ensata* may stem from the drawings of *C. longiclavata* by Nicholls (1969), in which the calli are erroneously illustrated in four widely spaced rows. Our recent population studies suggest that the calli of *C. ensata* are no more crowded than those of *C. longiclavata*.

Caladenia ensata differs from *C. longiclavata*, *C. magniclavata* and *C. arrecta* in its smaller flowers with relatively short osmophores and its very short labellum fringe calli usually to 1 mm long. From *C. arrecta*, *C. ensata* also differs in its obliquely downcurved petals and its calli in four densely crowded rows.

Caladenia ensata differs from *C. rhomboidiformis* in its narrower labellum and petals with osmophores. The distributions of these two species overlap only in the Nannup area, with *C. ensata* extending eastwards.

***Caladenia excelsa* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinibus *Caladenia longicauda* Lindl. scapis robustis 45–90 cm altis, floribus magnis et lamina labelli crenea ad basin marroninascenti ad apicem differt.

Typus: north-west of Margaret River, Western Australia, 4 October 1983, S.D. Hopper 3429 (*holo*: PERTH 00328979; *iso*: AD!, CBG!, K!, MEL!, NSW!, PERTH).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 55 (1990) [as the Giant Spider Orchid, *Caladenia* sp. (Leeuwin–Naturaliste) S.D. Hopper 4670]; N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 86 (1992) and rev. 2nd edn with suppl., p. 86 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 115 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 20–35 cm x 6–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 45–90 cm tall. *Flowers* 1–2(3), c. 7–15 cm across, greenish-white marked with maroon stripes and suffusions; floral odour faintly sweet. *Sepals and petals* stiff near base, becoming lax and pendulous, linear-lanceolate in basal seventh, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect basally, then arching backwards and becoming pendulous, 13–20 cm x 3–5 mm. *Lateral sepals* spreading obliquely downwards near base, then vertical, 13–20 cm x 5–7 mm. *Petals* spreading just below horizontal near base, then downcurved and vertical, 9.5–15 cm x 3–5 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, greenish white with faint red radiating basal stripes, apical lobe dark maroon, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate in outline when flattened, 25–35 x 12–17 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform dark maroon to pink white-tipped calli to 10 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, red-maroon, becoming white proximally, golf stick-shaped, the longest c. 2.5 mm tall, decrescent towards apex and becoming sessile. *Column* 18–23 x 8–12 mm, winged, creamy yellow with pink blotches. *Anther* c. 5 x 4 mm, pale greenish yellow with pink markings. *Pollinia* c. 5 mm long, yellow. *Stigma* c. 5 mm wide, yellow-green. *Capsule* not seen. (Figure 8L–R)

Selected specimens examined. WESTERN AUSTRALIA: near Margaret River, 8 10 1979, A. Brown s.n. (PERTH 00290904); E of Yallingup, 9 Oct. 1967, A.S. George 9210 (PERTH 00290912); W of Margaret River, 4 Oct. 1983, S.D. Hopper 3432 (PERTH 00237264); SW of Witchcliffe, 4 Oct. 1983, S.D. Hopper 3433 (PERTH 00237272); Leeuwin-Naturaliste National Park, ENE of Gracetown, 5 Oct. 1983, S.D. Hopper 3439 (PERTH 00237280); NW of Dunsborough, 25 Sep. 1985, S.D. Hopper 4653 (PERTH 00907537); SW of Margaret River, 28 Sep. 1985, S.D. Hopper 4670 (PERTH 00908592); between Dunsborough and Yallingup, 24 Sep. 1967, R. Jennings s.n. (PERTH 00914940); Leeuwin National Park, 3 Oct. 1988, G.J. Keighery 10333 (PERTH 01698885); near Cape Augusta, 18 Oct. 1962, F. Lullfitz 816 (PERTH 00290920).

Distribution and habitat. Confined to *Banksia* woodland amongst scattered Jarrah/Marri on deep grey sand soils of the Leeuwin–Naturaliste Ridge between Yallingup and Karridale. (Figure 9A)

Flowering period. Late September to early November.

Etymology. Named from the Latin *excelsus* (lofty, high), alluding to the height of the scapes, which, on robust specimens, are the tallest recorded in the genus.

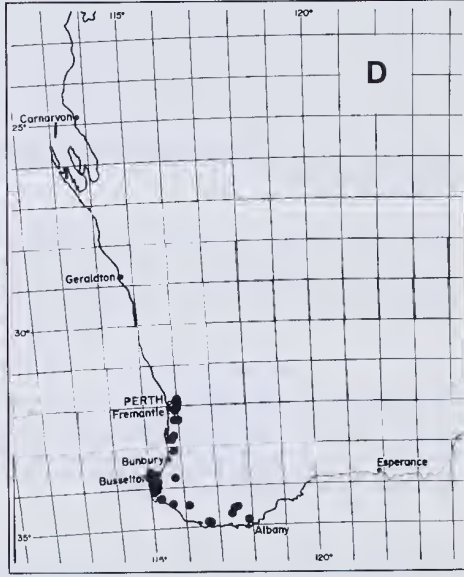
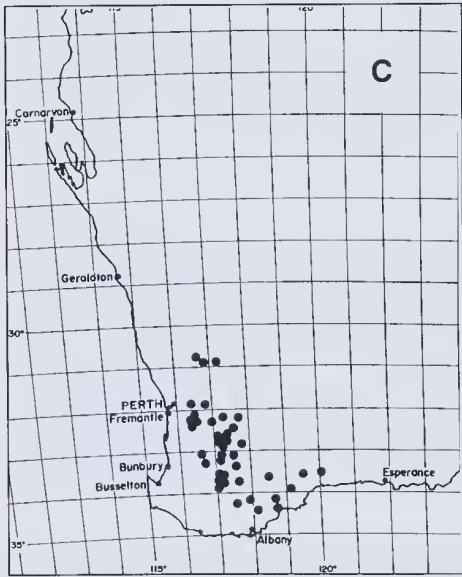
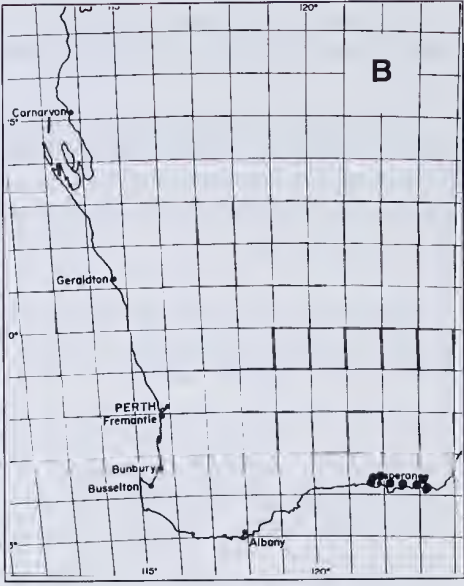
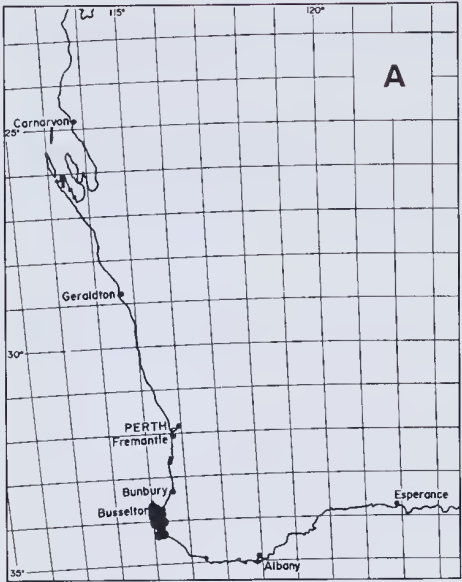


Figure 9. Distribution maps. A – *Caladenia excelsa*; B – *C. exstans*; C – *C. falcata*; D – *C. ferruginea*.

Notes. *Caladenia excelsa* occurs over a narrow geographical range and is currently declared as Rare Flora (Hopper *et al.* 1990, Brown *et al.* 1998). *C. excelsa* is the tallest and largest-flowered member of the *C. longicauda* complex. Indeed, robust specimens exceed all other species in the genus in height and flower size.

It is difficult on present evidence to identify the closest relatives of *Caladenia excelsa*. Its robust flowers are similar in size to those of *C. splendens*, but differ in the longer narrower labellum with a maroon apex and shorter fringe, and the longer more pendulous petals and sepals. *C. longicauda* subsp. *merrittii* is similar to *C. excelsa* in its long pendulous petals and sepals, but differs in its much smaller labellum with a white apex. There are similarities between *C. excelsa* and members of the *C. huegelii* group such as *C. lorea*, which have a red apex to the labellum and elongated petals and sepals, but differ in the golden-brown glandular hairs on the tepals and in their much smaller flowers. Possibly, *C. excelsa* provides a link between the *C. longicauda* and *C. huegelii* groups.

At the ecotones linking their respective habitats, *Caladenia excelsa* occasionally grows and hybridizes with *C. longicauda* subsp. *longicauda* (e.g. S.D. Hopper 5561, PERTH). It also may occur with *C. citrina*. It is readily distinguished from both these taxa by its larger flowers and the maroon labellum apex.

Caladenia exstans Hopper & A.P. Br., *sp. nov.*

A *Caladenia integra* E. Coleman floribus parvioribus labello brevioribus fimbria marginali, lobis lateralibus distincte acutis differt.

Typus: east of Esperance, Western Australia, 8 October 1985, S. D. Hopper 4678 (*holo:* PERTH 01707027; *iso:* AD!, CBG!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 119 (1992) and rev. 2nd edn with suppl., p. 119 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 5–20 cm x 4–6 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–45 cm tall. *Flowers* 1 or 2, c. 3–5 cm across, predominantly green to greenish-yellow with variable suffusions, lines and spots of dull maroon and dark purple; floral odour absent. *Sepals and petals* stiffly held, conspicuously marked with maroon suffusions and median stripes; osmophore slightly tumescent, 3–10 mm long on sepals, absent from petals, yellow or fawn, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* 3.5–4.5 cm x 2.5–3 mm, erect near base, curving forwards and then obliquely ascending in line with the column, linear in basal third, then abruptly narrowing and filiform below osmophore. *Lateral sepals* 3–4.5 cm x 4–5 mm, splayed forwards and downwards for the first c. 1 cm then curving inwards and obliquely upwards, base narrowly lunate, then abruptly narrowing as for dorsal sepal. *Petals* usually straight, spreading obliquely downwards and backwards, 2–3 cm x c. 2 mm. *Labellum* prominently 3-lobed, 2-coloured, yellowish-green, terminating in a uniformly dark purple forward projecting apex, loosely articulate on a claw c. 1.5 mm wide; lamina hastate with the lateral lobe apices curved forward and shortly acute, the midlobe 4–6 mm wide somewhat dilated apically and rostellate with a short acute apex when flattened, 11–13 x 14–15 mm, basal third erect, distal 2/3 horizontal, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending margins; lateral lobes erect with entire proximal margins; midlobe margins entire proximally, becoming shortly dentate with broad slightly forward-facing obtuse simple calli. *Lamina calli* in densely congested in a medial band extending at least 3/4 the length of the labellum (onto the dark purple apex), dark purplish-maroon, golf stick-shaped, the longest c. 3 mm tall, decrescent towards apex

and becoming sessile. *Column* 13–25 x 6–8 mm, narrowly winged, wings flat near base, pale yellow-green with pinkish blotches. *Anther* c. 3–4 x 3 mm, greenish-yellow. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 3 mm wide, dark dull maroon to pale green. *Capsule* not seen. (Figure 8S–Y)

Selected specimens examined. WESTERN AUSTRALIA: Thomas River, Esperance District, *s.d.*, *Anonymous s.n.* (PERTH 00264571); Cape Arid National Park, 30 Oct. 1989, *G.J. Keighery* 11188 (PERTH01308637); Thomas River, Cape Arid National Park, *R.W. Pemberton s.n.* (PERTH 1828363); c. 104 km E of Esperance, 20 Sep. 1977, *N.C. Verco s.n.* (PERTH 00264628).

Distribution and habitat. Occurs in scattered populations in near-coastal districts between the Esperance district and Israelite Bay, usually growing in shallow soil pockets on granite outcrops, but may also occasionally be found in deeper soil under shrub thickets immediately adjacent to granite outcrops or in Swamp Yate flats. Soil is granitic loam. (Figure 9B)

Flowering period. Late September to October.

Etymology. Named from the Latin *exstans* – projecting, alluding to the labellum which projects forward rather than curling under as in most species of *Caladenia*.

Notes. A scattered and uncommon species, that was at one time declared as Threatened Flora (Hopper *et al.* 1990) but is now known to be well reserved (Priority Four). *Caladenia exstans* is related to *C. integra*, from which it differs in its smaller flowers, its less prominently upturned lateral sepals, its shorter prominently lobed labellum with calli extending well onto the dark purple apex, its broader apical mid lobe, and its easterly distribution.

Caladenia exstans is also related to *C. attingens*, *C. falcata*, *C. longifimbriata* and *C. dilatata*, all of which have fine marginal combing on the lateral lobes of the labellum. A rare hybrid of *C. exstans* and *C. attingens* has been recorded at Lort River (*C. French*, pers. comm.).

Caladenia falcata (Nicholls) M. Clements & Hopper, *Australian Orchid Research* 1: 24 (1989). – *Caladenia dilatata* var. *falcata* Nicholls, *Victorian Naturalist* 65: 268, f. (1949). *Type:* Kojonup, Western Australia, 26 September, *W.H. Nicholls s.n.* (*holo:* MEL!; *iso:* MEL!).

Illustrations. As *Caladenia dilatata* var. *falcata* unless otherwise stated. E. Pelloe, *West Australian Orchids*, frontispiece colour plate, no. 1 (1930); W. Blackall & B. Grieve, *How to Know Western Australian Wildflowers*, Part 1, p. 93 (1954); R. Erickson, *Orchids of the West*, 2nd edn, frontispiece no. 2 (1965); W. Nicholls, *Orchids of Australia*, plate 265c (1969); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 22 right photo (undated); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st edn, p. 129 plate 403 (1973); D. Jones, *Native Orchids of Australia*, illustration bottom left, p. 114 (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 128 (1984), 2nd edn, p. 116 [as *C. falcata*] (1992) and rev. 2nd edn with suppl., p. 116 [as *C. falcata*] (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–20 cm x 5–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1 or 2(3), c. 5–8 cm across, predominantly green to greenish-yellow with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal third, then abruptly narrowing and filiform below osmophore; osmophore slightly tumescent, 8–20 mm long on sepals, absent or 6–15 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal*

sepal erect and slightly to prominently incurved, 4.5–8 cm x 3–4 mm. *Lateral sepals* 3.5–7.5 cm x 3–5 mm, held below horizontal for the first 1.5–2 cm then curving upwards and inwards vertically, base narrowly lunate. *Petals* straight, spreading obliquely downwards and backwards, 3.5–5.5 cm x 2–3 mm. *Labellum* prominently 3-lobed, 2-coloured, yellowish-green, terminating in a uniformly dark maroon-purple recurved apex, loosely articulate on a claw c. 2–2.5 mm wide; lamina hastate with the lateral lobe apices curved forward and the midlobe narrowly triangular and acute in outline when flattened, 15–24 x 20–30 mm, basal third erect, distal 2/3 horizontal except for a shortly recurved apex, margins at widest point deeply curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire proximal margins from the claw to the apex, then abruptly fimbriate comb-like with slender linear yellowish-green calli to 8 mm long which are decrescent (sometimes abruptly) near midlobe; midlobe margins with short slender slightly forward-facing obtuse simple calli decrescent towards the apex. *Lamina calli* in 4 densely congested rows extending only half the length of the labellum (stopping well short of the dark maroon-purple apex), dark purplish-maroon, golf stick-shaped, the longest c. 5 mm tall, decrescent towards the apex and becoming sessile. *Column* 17–22 x 7–10 mm, broadly winged, wings undulate near base, pale yellow-green with pinkish blotches. *Anther* c. 3–4 x 3–4 mm, greenish-yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3.5 mm wide, dark dull maroon to pale green. *Capsule* not seen. (Figure 10A–D)

Selected specimens examined. WESTERN AUSTRALIA: Nightwell Rd, 12.5 km ESE of Chester Pass Rd, 34°13'S, 118°22'E, 14 Oct. 1986, A. Brown 465 (PERTH 00928658); Fitzgerald River, between Ravensthorpe and Jerramungup, 8 Sep. 1979, A. Brown s.n. (PERTH 00848794); Pauls Valley, N of Cranbrook, 14 Sep. 1931, R. Erickson s.n. (PERTH 00845388); 33.3 km N of Kojonup, 800 m S of Woodanilling turnoff on Albany Highway, 33°32'S, 117°09'E, 20 Sep. 1985, S.D. Hopper 4630 (CBG, PERTH 00903221); Dale West Rd, c. 4.2 km NE of Brookton Highway, 32°14'S, 116°29'E, 12 Oct. 1986, S.D. Hopper 5641 (CBG, PERTH 01189832); NE side of the intersection of Elverdton Rd and the Hopetoun–Ravensthorpe road, c. 10 km SE of Ravensthorpe, 33°38'S, 120°09'E, 29 Sep. 1987, S.D. Hopper 6139 (PERTH 01195166); Fowlers Gully, Wongan Hills, 194 km NE of Perth, 30°49'S, 116°38'E, 21 Sep. 1974, K.F. Kenneally 2325 (PERTH 01220411).

Distribution and habitat. Extends throughout the western and southern wheatbelt from Wongan Hills to the Jerramungup area, in a variety of habitats from open Wandoo and Jam woodland, and dense Rock Oak thickets surrounding inland granite outcrops, to low shrublands adjacent to watercourses. Recently found in the north-east suburbs of Perth in a paperbark (*Melaleuca preissiana*) swamp. (Figure 9C)

Flowering period. September to October.

Notes. *Caladenia falcata* was regarded as a variety of *C. dilatata* until it was raised to specific rank by Clements & Hopper (in Clements 1989). It differs from *C. dilatata*, however, in its upturned lateral sepals, its uniformly yellow-green labellum lamina (except for the dark maroon apex), and its calli stopping well short of the dark apex. Most members of the eastern Australian *C. dilatata* complex differ conspicuously from *C. falcata* (and *C. attingens*) in the labellum lamina adjacent to the dark maroon apex being white rather than green.

Caladenia falcata sens. lat. was considered, prior to our research, to be a widespread and variable taxon, found throughout the south-west of Western Australia from Israelite Bay to Augusta and northwards to the Wongan Hills area. However, we now know typical *C. falcata* to be confined to the Wongan Hills–Jerramungup area, while the taxon found between Bunbury and Albany, and also to the east of Jerramungup, is described herein as *C. attingens*. *C. falcata* differs from *C. attingens* in its larger flowers, its broadly winged column, the wings undulate basally, and its labellum with calli extending

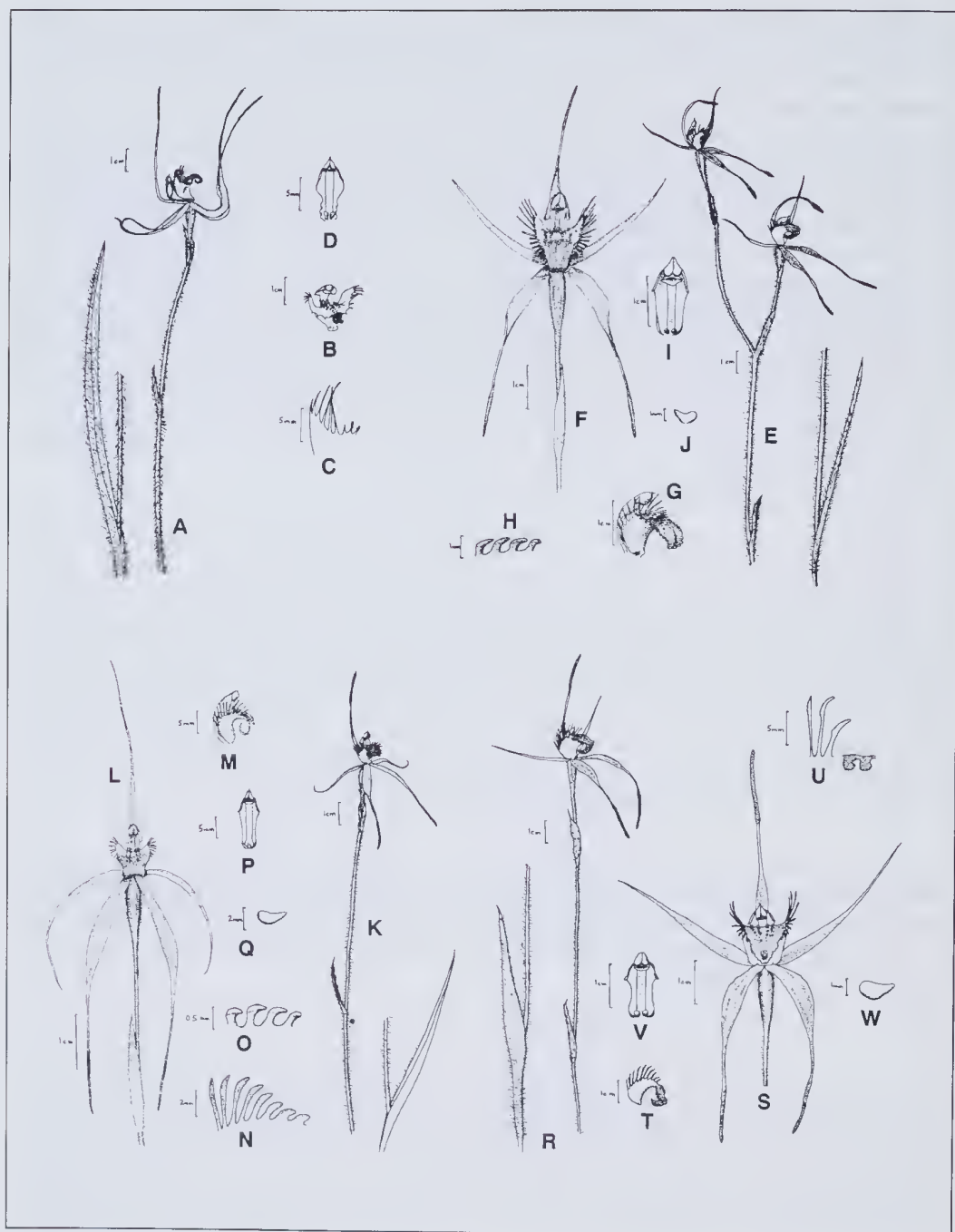


Figure 10 A-D. *Caladenia falcata* from the Toolibin area, S.D. Hopper 4121. A - plant; B - labellum and column; C - labellum fringe; D - column from front. E-J. *C. ferruginea* from the Busselton area, A.P. Brown 252. E - plant; F - flower; G - labellum and column from side; H - calli; I - column from front; J - pollinia. K-Q. *C. gardneri* from Warren Beach, S.D. Hopper s.n. K - plant; L - flower; M - labellum and column from side; N - labellum fringe; O - calli; P - column from front; Q - pollinia. R-W. *C. georgei* from Yalgorup National Park, S.D. Hopper 4142. R - plant; S - flower; T - labellum from side; U - labellum fringe; V - column from front; W - pollinia. Drawn by S.J. Patrick.

only half the length of the lamina (stopping well short of the dark maroon apex).

Experimental bait trials have established that *Caladenia falcata* and *C. attingens* attract different species of thynnid wasps as pollinators (A. Brown, unpubl.).

Caladenia ferruginea Nicholls, *Victorian Naturalist* 64: 136, f. (1947). *Type*: Armadale, Western Australia, September 1946 *W.H. Nicholls s.n. (lecto: MEL!, fide George (1971: 172))*. *Excluded syntype*: between Yarloop and Cookernup, Western Australia, October 1946, *W.H. Nicholls s.n. (MEL!)*.

Illustrations. W. Nicholls, *Orchids of Australia*, plate 254 (1969); D. Jones, *Native Orchids of Australia*, p. 117, illustration top right (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 65 top left (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 108, [as *Caladenia* sp.] (1984), 2nd edn, p. 109 (1992) and rev. 2nd edn with suppl., p. 109 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 12–22 cm x 4–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–60 cm tall. *Flowers* 1–3(5), c. 4–6 cm across, predominantly brownish-red; floral odour absent or faintly musky. *Sepals* and *petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 7–12 mm long on sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly to prominently incurved, 3.5–5 cm x 2.0–2.5 mm. *Lateral sepals* spreading obliquely downwards, 3–5 cm x 3–4 mm. *Petals* curved obliquely upwards to a narrowly acute apex, 2.5–4 cm x 2–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white to golden yellow with brownish-red radiating stripes, terminating in a uniformly brownish-red recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-cordate to cordate in outline when flattened, 15–20 x 10–13 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acute linear brownish-red to golden yellow (sometimes white-tipped) calli to 7 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending about half the length of the labellum (occasionally reaching and extending onto the dark-coloured apex), golden yellow to brownish-red with white bases, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 12–15 x 7–9 mm, winged, creamy yellow with brownish-red blotches. *Anther* c. 3 x 3 mm, brownish-red. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide, dark yellow-green. *Capsule* not seen. (Figure 10E–J)

Selected specimens examined. WESTERN AUSTRALIA: Cabunup, intersection of Wildwood Rd and Bussell Highway, 33°42'S, 115°12'E, 14 Oct. 1985, A. Brown 252 (PERTH 00905445); corner of Brixton St and Alton St, Beckenham, 23 Sep. 1982, A. Brown s.n. (PERTH 00262382); 75 km E of Cowaramup, 33°51'S, 115°01'E, 27 Oct. 1984, E. Chapman s.n. (PERTH 00404381); Walpole, 27 Sep. 1960, *Forest Department s.n.* (PERTH 00326569); Yallingup, 8 Oct. 1967, A.S. George 9203 (PERTH 00249742); Kenwick, 10.5 km SW of East Cannington Post Office, junction of Brixton Rd and Alton St, 32°02'S, 115°59'E, 13 Sep. 1983, S.D. Hopper 3377 (AD, CBG, PERTH 00242039); 1 km W of Thomson Rd on Muirs Highway, 34°26'S, 116°37'E, 3 Oct. 1983, S.D. Hopper 3416 (PERTH 00242047); 13 km SE of Margaret River, 9 km NE of Witchcliffe, 34°00'S, 115°11'E, 4 Oct. 1983, S.D. Hopper 3421 (PERTH 00328456); 2 km W of Mount Barker, 1.9 km W of Albany Highway on Muirs Highway, 34°37'S, 117°38'E, 8 Oct. 1983, S.D. Hopper 3516 (CBG, PERTH 00242098); 700 m W of

Rocky Point, 300 m up from ocean, 33°33'S, 115°03'E, 22 Sep. 1986, S.D. Hopper 5514 (PERTH 00873667).

Distribution and habitat. Common in the Busselton–Margaret River area in Jarrah/Marri forest, coastal Peppermint woodlands and winter-wet flats. Also of scattered occurrence northwards in clay-based swamps to Perth and eastwards in swampy areas to Porongurup Range. Soils range from deep sands and lateritic loams to sandy clays. (Figure 9D)

Flowering period. September to November.

Notes. Named by Nicholls in 1947, *Caladenia ferruginea* was later reduced to synonymy with *C. huegelii* by George (1971), who did recognize the species but misapplied the name *Caladenia pectinata* to it. Rye (1987) reinstated *C. ferruginea* to its former rank on our advice (after SDH had examined the types in 1984).

Caladenia ferruginea is one of the most distinctive members of the *C. huegelii* group, readily recognized by its brownish-red colouration with a prominent thickened osmophore on the sepals and absent from the stiffly upswept petals, and the labellum central calli usually stopping short of the dark-coloured apex. It is often found growing in swamps with *C. paludosa*, which differs from *C. ferruginea* in its larger flowers with sepals, petals and the basal labellum lamina all greenish, and its much thicker shorter labellum fringe segments.

***Caladenia gardneri* Hopper & A.P. Br., sp. nov.**

A speciebus ceteris gregis *Caladenia huegelii* H. G. Reichb petalis sepalisque acute declinatis, plerumque diluto-roseis, marginibus cremeis, sepalis lateralibus 4–7.5 cm longis et 3–6 mm latis, cum clavis gracilibus, cano-roseis ad diluto-brunneis, 6–30 mm longis, petalis 3.5–5 cm longis, 2–4 mm latis, labello 17–25 mm longo et 7–10 mm lato, ad apicem atro-roseo, lamina basali alba ad diluto-rosea cum lineis roseis radiantibus, labelli fimbria segmentis gracilibus leviter clavatis atro-roseis ad 6 mm longis differt.

Typus: 3.6 km west of Scott River Bridge on Four Acres Rd, 48 km west-north-west of Pemberton, 34°17'S, 115°02'E, Western Australia, 8 October 1984, S.D. Hopper 4279 (*holo:* PERTH 00330876; *iso:* AD!, CBG!, K!, MEL!, NSW!, PERTH).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 96 (1992) and rev. 2nd edn with suppl., p. 96 (1998).

Plant solitary or in loose colonies. *Leaf* erect, linear, 8–20 cm x 4–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 10–25 cm tall. *Flowers* 1 or 2, c. 4–8 cm across, white with prominent suffusions and markings of deep to pale pink; floral odour strongly sweet. *Sepals and petals* stiffly held, linear-lanceolate in basal half to third, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 6–30 mm long on sepals, absent from petals, greyish-pink to light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4–6 cm x 3–3.5 mm. *Lateral sepals* acutely downcurved to vertical, 4–7.5 cm x 3–6 mm. *Petals* spreading horizontal then downcurved to vertical apices, 3–5.5 cm x 2–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, basal half of lamina white with pale pink radiating stripes, distal half uniformly dark pink with a recurved apex, stiffly articulate on a claw

c. 1.5 mm wide; lamina linear-cordate in outline when flattened, 17–25 x 7–10 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by obliquely ascending calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with slender clubbed narrowly fusiform dark pink calli to 6 mm long which are abruptly or evenly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least $\frac{3}{4}$ – $\frac{4}{5}$ the length of the labellum, dark pink (paler proximally), sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 16–19 x 6–9 mm, broadly winged, creamy yellow with pink blotches. *Anther* c. 2.5 x 2.5 mm, pink and greenish yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3 mm wide, pinkish. *Capsule* not seen. (Figure 10K–Q)

Selected specimens examined. WESTERN AUSTRALIA: Leeuwin–Naturaliste National Park, 2.3 km N of Cape Leeuwin Lighthouse, 34°22'S, 115°10'E, 10 Oct. 1983, S.D. Hopper 3576 (AD, BRI, CBG, K, MEL, PERTH 00330892); base of Yaegerup Dunes, 20 km SW of Pemberton, 34°33'S, 115°52'E, 8 Oct. 1984, S.D. Hopper 4263 (CBG, PERTH 00249785); Caves Rd, 200 m S of Yallingup Rd, 33°40'S, 115°02'E, 24 Sep. 1986, S.D. Hopper 5541 (PERTH 00874124); Point Matthew, S of Augusta, 34°22'S, 115°09'E, 2 Oct. 1986, S.D. Hopper 5616 (PERTH 01709437); Deeside Coast Rd, 7.5 km S of Chesapeake Rd, W of Broke Inlet, 34°51'S, 116°15'E, 29 Oct. 1987, S.D. Hopper 6296 (CBG, PERTH 01192477); between Black Point and White Point, 7.1 km E of Spring Ocean Track, 34°23'S, 115°31'E, 30 Oct. 1987, S.D. Hopper 6312 (PERTH 01710583); Warren Beach Rd, 26 Oct. 1974, S.D. Hopper s.n. (PERTH 00250694).

Distribution and habitat. Ranges from the Leeuwin–Naturaliste Ridge eastwards along the south coast to William Bay. Usually confined to near-coastal consolidated dunes beneath Peppermint open low woodland or low heath. (Figure 11A)

Flowering period. September to November.

Etymology. Named after Mr George Gardner (1912–) of Northcliffe, farmer, timber worker and council employee, who has an exceptional knowledge of the natural history, geology and anthropology of the southern forest region, and who was the first to show the senior author this species (in 1974) and recognize it as a distinct *Caladenia*. George has provided useful and congenial assistance to both of us on several subsequent trips in search of interesting and elusive orchids and other plants.

Notes. A locally common species, *Caladenia gardneri* is one of five pink spider orchids found in the lower south-west. It is similar to *C. applanata*, with which it sometimes grows, but differs in its paler pink and acutely downcurved petals and sepals, more slender osmophores, narrower labellum, and finer calli. The three other pink spiders, *C. harringtoniae*, *C. starteorum* and *C. winfieldii*, grow further inland, in swamps in the southern forests, and neither *C. harringtoniae* nor *C. winfieldii* has swollen osmophores on the sepals like *C. gardneri*. *C. winfieldii* also has a shorter column (13–16 mm) compared with that of *C. gardneri* (16–19 mm tall). *C. starteorum* differs from *C. gardneri* in its darker pink colouration, its broader labellum, and its longer and more slender osmophores.

Caladenia gardneri was first collected (from Cape Leeuwin) by a Mrs W.E. Cooke, probably in October 1906 when she also collected *C. marginata* and *Leptoceras menziesii* R. Br. from Karridale. Mrs Cooke was a correspondent of the noted South Australian orchidologist Dr R.S. Rogers, to whom she forwarded her specimens. The collection of *C. gardneri* was mixed with plants of four other species (*C. infundibularis*, *C. brownii*, *C. huegelii* and *C. applanata*), all mounted on the same sheet

(AD 97705515) and labelled initially by Rogers as "*C. dilatata* Br.", but with a subsequent pencil slash through this determination and no alternative provided.

No further collections of *Caladenia gardneri* were made until 1967, when R. Jennings and A.S. George documented the occurrence of the species at Yallingup within a month of each other. Like Rogers, George was undecided as to the specific status of these collections, and did not describe them as a new species in his subsequent publications (George 1971, 1987).

Caladenia georgei* Hopper & A.P. Br., *sp. nov.

A speciebus aliis affinibus *Caladenia huegelii* H.G. Reichb. petalis sepalisque plerumque pallido-
viridibus suffusis hebetibus pallido-marroninis, sepalis lateralibus clavis gracilibus pallido glandaceis
13–40 mm longis, et fimbria labelli segmentorum acutorum gracilium atroseis ad apicem albidis
differt.

Typus: Bunbury, 200 m east of consolidated coastal dunes, c. 1.3 km west of Harewoods Rd on sand track, 33°26'S, 115°37'E, Western Australia, 17 October 1986, S.D. Hopper 5789 (*holo*: PERTH 01751557; *iso*: AD!, CBG!).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 106 (1992) and rev. 2nd edn with suppl., p. 106 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 12–22 cm x 5–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–50 cm tall. *Flowers* 1 or 2(3), c. 5–8 cm across, predominantly yellowish-green to white with variable suffusions, lines and spots of dull maroon; floral odour absent or faint, sweet, like custard. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 23–40 mm long on dorsal sepal, 13–40 mm long on lateral sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 5–7.5 cm x 2.5–3.0 mm. *Lateral sepals* obliquely downcurved, 4.5–8.5 cm x 4–6 mm. *Petals* horizontal to obliquely downcurved, 4.5–5 cm x 2.5–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white with dull maroon radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 1.5–2 mm wide; lamina linear-cordate to cordate in outline when flattened, 12–25 x 10–18 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear dark maroon white-tipped calli to 12 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 18–20 x 8–10 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 4 x 4 mm, yellowish green and dark maroon. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 4 mm wide, dark yellowish brown. *Capsule* not seen. (Figure 10R–W)

Selected specimens examined. WESTERN AUSTRALIA: Dunsborough, 7 Oct. 1979, A.P. Brown s.n. (PERTH 00233013); Bold Park, Floreat Park, 8 km W of Perth, 14 Sep. 1988, G.J. Keighery 11226 (PERTH 01668013); Thomsons Lake, Perth, 9 Oct. 1989, G. Graham s.n. (PERTH 01035347); 4 km SSW of Yallingup, 1 km S of Canal Rocks turn off on Caves Rd, 33°41'S, 115°01'E, 5 Oct. 1983,

S.D. Hopper 3443 (PERTH 00256005); Yalgorup National Park, 300 m W of Mandurah–Bunbury road on Preston Beach Rd, 32°13'S, 115°43'E, 12 Sep. 1984, *S.D. Hopper* 4142 (PERTH 00232157); Australind, 0.5 km N of Cathedral Ave, on Old Coast Rd, SE side of road, 33°16'S, 115°44'E, 9 Sep. 1985, *S.D. Hopper* 4503 (AD, CBG, K, PERTH 01709038); Quinns Rd, c. 300 m W of Lancelin Rd, c. 12 km NNW of Wanneroo, 31°40'S, 115°43'E, 13 Sep. 1987, *S.D. Hopper* 6032 (CBG, PERTH 01667025); Yanchep National Park, 10 Sep. 1965, *E.M. Scrymgeour* 54 (PERTH 00232602).

Distribution and habitat. Ranges from Yanchep to Busselton near the coast on calcareous sands of the Spearwood Dune System, often in Tuart or Peppermint woodland. (Figure 11B)

Flowering period. September to October.

Etymology. Named after Mr Alexander S. George (1939–), Botanist initially at the Western Australian Herbarium, then Executive Editor of the “Flora of Australia” in Canberra, and more recently self-employed in Perth, who has had a lifelong interest in Western Australian orchids, and whose check list of the Orchidaceae of Western Australia (1971) and other publications have been seminal in modern work on these plants. Alex named the genera *Elythranthera* and *Leporella*, as well as eleven new species or varieties of Western Australian orchids, and grew up in the Fremantle area where *Caladenia georgei* still may be found.

Notes. A locally common species restricted to a narrow geographical range subject to increasing urban and industrial development. *Caladenia georgei* is related to *C. huegelii*, but differs in its smaller flowers, petals much shorter than sepals, shorter labellum fringe lacking bifurcations near the tips, and finer calli. *C. georgei* is also similar to *C. thinicola*, from which it differs in its larger flowers and more northerly range of distribution. *C. georgei* is more distantly related to *C. arenicola*, with which it hybridizes where their ranges overlap along the junction of the Spearwood and Bassendean Dunes (eg. at Joondalup in Perth’s northern suburbs). However, *C. georgei* differs from *C. arenicola* in its paler colouration, its petals lacking osmophores and much shorter than sepals, its sepals with shorter thicker osmophores, and longer (to 12 mm) finer labellum fringe calli with acute tips.

Caladenia granitora* Hopper & A.P. Br., *sp. nov.

A speciebus aliis affinis *Caladenia huegelii* H.G. Reichb. labello complanato extruso, deorsum curvato prope apicem, lamina ad basin albida, prope fimbriam virella vittis suffusionibusque radiatis atroseis differt.

Typus: east end of Normans Beach near Mt Manypeaks, 34°55'S, 118°16'E, Western Australia, 8 October 1987, *S.D. Hopper* 6215 (*holo:* PERTH 01751573; *iso:* CBG!).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 112 (1992) and rev. 2nd edn with suppl., p. 112 (1998).

Plant solitary, rarely in loose clumps. *Leaf* erect, linear, 10–18 cm x 6–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–35 cm tall. *Flowers* 1 or 2, c. 3–5 cm across, predominantly yellowish-green to white with variable suffusions, lines and spots of maroon to pinkish-maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal half to a third, then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 6–10 mm long on sepals, absent from petals, light golden brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3–4.5 cm x 2.0–2.5 mm. *Lateral sepals* obliquely

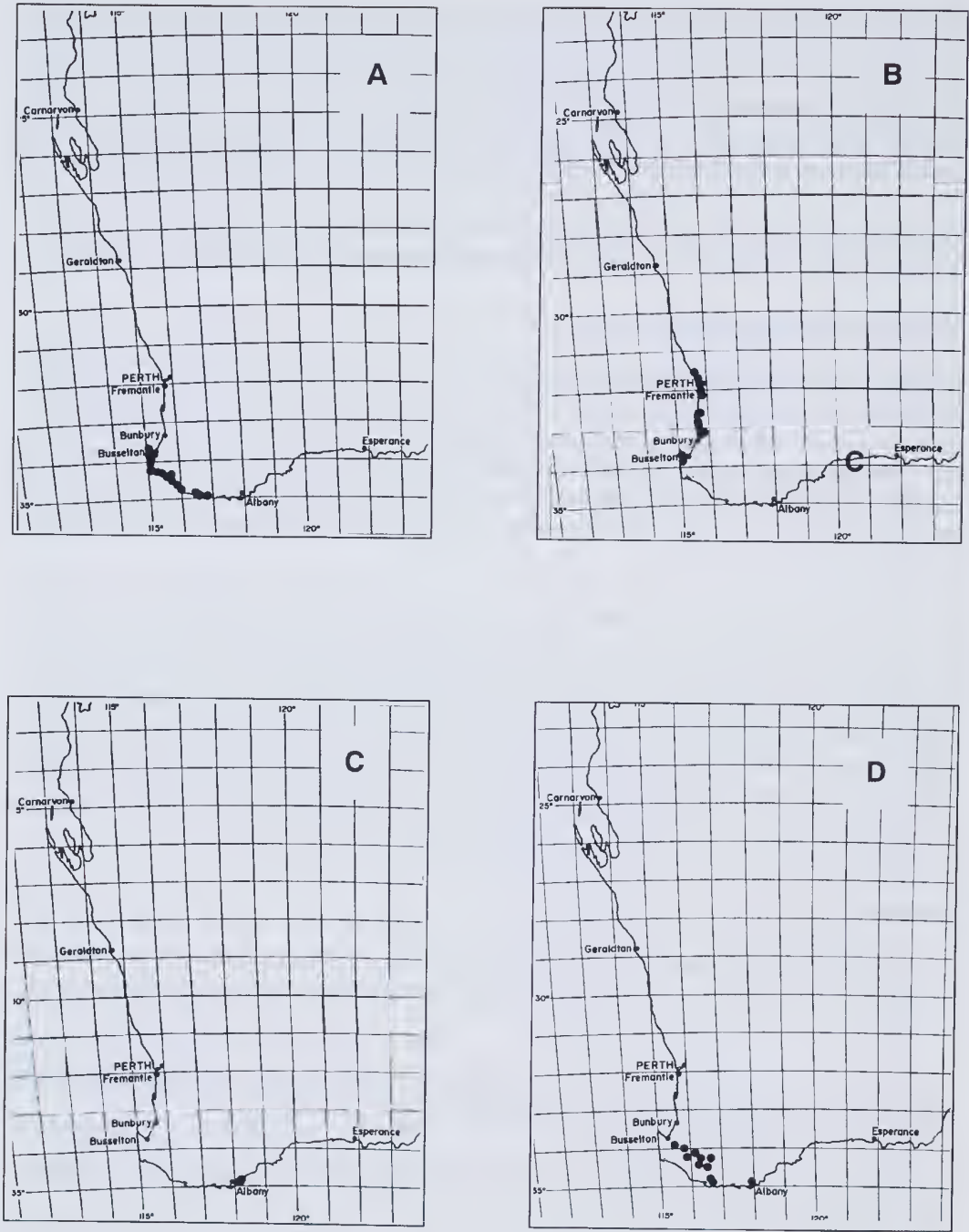


Figure 11. Distribution maps. A – *Caladenia gardneri*; B – *C. georgei*; C – *C. granitora*; D – *C. harringtoniae*.

downcurved, 3.5–4 cm x 3.0–3.5 mm. *Petals* horizontal to obliquely downcurved, 3.0–3.5 cm x 2.5–3 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white or greenish-cream sometimes with pinkish maroon radiating stripes and suffusions confined to outer marginal areas of the lateral lobes near fringing calli, terminating in a uniformly dull maroon recurved apex usually occupying less than half the midlobe, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-cordate to cordate in outline when flattened, 18–22 x 11–13 mm, basal quarter curving from erect to oblique, middle half slightly curved to horizontal and flattened laterally, apical quarter sharply downcurved with incurved margins so as to be channelled medially, almost forming a funnel, margins at widest point flattened and terminated by slightly ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear pinkish-maroon white-tipped calli to 4 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending 1/3–1/2 the length of the labellum, cream, golf stick-shaped, the longest c. 1.5 mm tall, slightly decrescent towards apex. *Column* 12–15 x 6–8 mm, broadly winged, creamy yellow. *Anther* c. 2–2.5 x 2–2.5 mm, yellowish green. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide, dark yellowish brown. *Capsule* not seen. (Figure 12A–G)

Selected specimen examined. WESTERN AUSTRALIA: *s. loc.*, 31 Oct. 1987, B. Buirchell *s.n.* (PERTH 01668560).

Distribution and habitat. Confined to coastal granite headlands and slopes between Albany and Cheyne Beach, where it grows in shallow soil over sheet granite in low heath and herbfields. (Figure 11C)

Flowering period. October to November.

Etymology. Named from the rock granite and Latin *ora* – coast, alluding to the habitat occupied by the species.

Notes. A rare and restricted species (Priority Two), first collected by S.D. Hopper in 1987. *Caladenia granitora* is most closely related to *C. infundibularis*, which has a similar flattened labellum that projects outwards before turning down just near the apex, and also often occurs in granitic coastal heath. *C. granitora* differs in its paler colouration (especially the mainly white labellum midlobe) and smaller flowers in all respects, as well as its more easterly distribution.

Caladenia stellata D.L. Jones & M.A. Clem. in southern New South Wales and South Australia has a flattened projecting labellum with a short fringe similar to those of *C. granitora* and *C. infundibularis*, but its petals and sepals are pale yellow-green, its lateral sepals have dark brownish-maroon clubs, and its labellum has a basal lamina that is green with dark maroon calli extending well forward onto the red apical lamina. It seems probable that *C. granitora*, *C. infundibularis* and the eastern Australian taxon *C. stellata* are relicts, persisting from a time when the south-west and South Australia were connected with suitable mesic habitat. There are several examples of this kind of east-west relationship among diverse groups in the southern Australian flora, as well as many species that occur either side of the Nullarbor (Nelson 1974, 1981).

The unusual labellum of *Caladenia granitora* distinguishes it from all other members of the *C. huegelii* complex in the Albany area such as *C. pectinata* and *C. heberleana*.

Caladenia harringtoniae* Hopper & A.P. Br., *sp. nov.

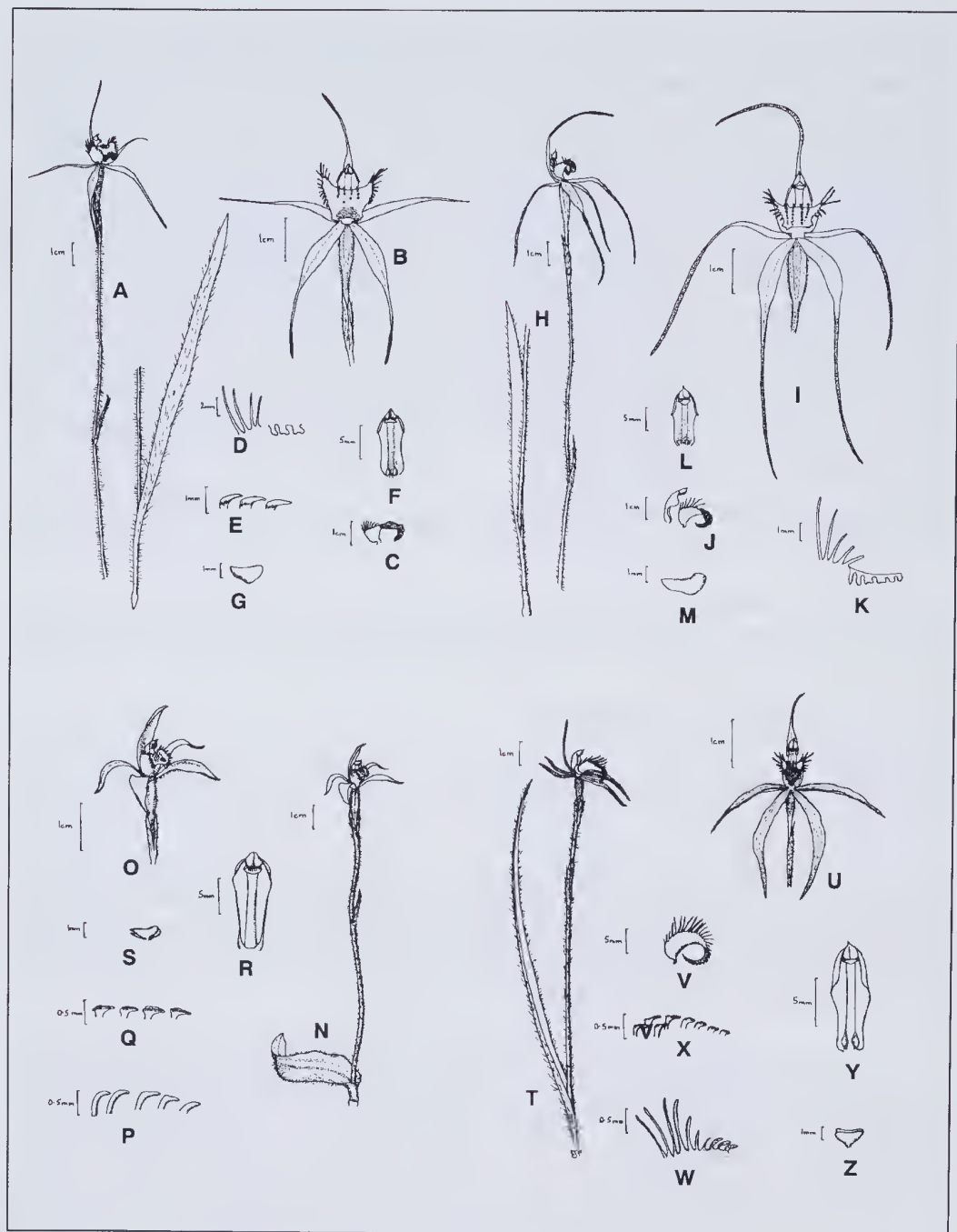


Figure 12 A-G. *Caladenia granitora* from the Mt Many Peaks area, S.D. Hopper 6215. A - plant; B - flower; C - labellum from side; D - labellum fringe; E - calli; F - column from front; G - pollinia. H-M. *C. heberleana* from Gibson, S.D. Hopper 4690. H - plant; I - flower; J - labellum and column from side; K - labellum fringe; L - column from front; M - pollinia. N-S. *C. hirta* subsp. *rosea* from Boorabbin Rock, S.D. Hopper 3979. N - plant; O - flower; P - labellum fringe; Q - calli; R - column from front; S - pollinia. T-Z. *C. hoffmanii* subsp. *hoffmanii* from near Northampton, A.P. Brown s.n. T - plant; U - flower; V - labellum from side; W - labellum fringe; X - calli; Y - column from front; Z - pollinia. Drawn by S.J. Patrick.

A speciebus aliis *Caladenia longicauda* Lindl. affinibus floribus parvis pallido-roseis et labello fimbria marginali breve ad 2–5 mm longa differt.

Typus: near Pemberton, Western Australia, 29 October 1987, S.D. Hopper 6306 (*holo*: PERTH 01192469; *iso*: CBG!).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 61 (1990) [as *Caladenia* sp. (Southern Forest) S.D. Hopper 3553, Harrington's Spider Orchid]; N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 96 [as *Caladenia* sp.] (1984), 2nd edn, p. 92 (1992) and rev. 2nd edn with suppl., p. 92 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 133 (1998).

Plant solitary or in loose colonies. *Leaf* erect, linear, 15–25 cm x 6–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1–3, c. 5–7 cm across, deep to pale pink, with white markings; floral odour sickly sweet. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* 4.5–7 cm x 2–3 mm, erect and slightly incurved. *Lateral sepals* spreading then obliquely downcurved to vertical, 5–8 cm x 4–7 mm. *Petals* spreading horizontal then downcurved sometimes with vertical apices, 3–4.5 cm x 3–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, basal half of lamina white with pale pink radiating stripes, distal half uniformly dark pink with a recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-cordate in outline when flattened, 13–18 x 7–12 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with slender clubbed narrowly fusiform dark pink to cream calli to 5 mm long which are abruptly or evenly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3–3/4 the length of the labellum, dark pink (paler proximally), sometimes white at base, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 12–14 x 5–6 mm, broadly winged, creamy yellow with pink blotches and suffusions. *Anther* c. 2–2.5 x 2–2.5 mm, pink and greenish yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5–3 mm wide, pinkish. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: Beedelup National Park, 25 Oct. 1984, G. Gardner s.n. (PERTH 00332291); Albany, 28 Sep. 1983, R. Heberle s.n. (PERTH 00260355); near Walpole, 16 Oct. 1986, S.D. Hopper 5748 (PERTH 01698893); near Pemberton, 29 Oct. 1987, S.D. Hopper 6306 (PERTH 01192469); N of Walpole, 24 Oct. 1989, W. Jackson BJ127 (PERTH 01669079).

Distribution and habitat. Confined to the Albany–Nannup area where it grows in winter-wet flats under scattered *Banksia littoralis* and *Melaleuca preissiana* with *Xanthorrhoea* prominent in the understorey, or on the margins of fresh-water lakes in *Melaleuca cuticularis* low forest and woodland. A single population has been found on a granite complex near Albany. Soils are sandy loams. Flowers in greatest abundance after fire. (Figure 11D)

Flowering period. Late October to November.

Etymology. Named after Alison J. Harrington (1949–), podiatrist, originally from Keith, South Australia, who moved to Perth in 1976 and was President of the Western Australian Native Orchid Study

and Conservation Group for the period 1981–1983 during which we also served on the Committee. Alison developed an interest in terrestrial orchids in South Australia, and has enthusiastically promoted the study and conservation of Western Australian orchids.

Notes. *Caladenia harringtoniae* is declared as Rare Flora (Brown *et al.* 1998). We have seen only a few widely scattered populations between Albany and Nannup. At one location it grows with *C. winfieldii*, which flowers at the same time, but hybrids have not been recorded. *C. harringtoniae* has also been collected once at the same site as *C. christineae*. It often grows with, but flowers a month earlier than *C. serotina*.

Caladenia harringtoniae is one of the smallest-flowered members of the *C. longicauda* complex. Its nearest relative appears to be *C. winfieldii*, but *C. harringtoniae* differs in its slightly smaller paler pink flowers, its narrower sepals with tapering apices; its smaller labellum, white near the base becoming pink towards the apex, and its shorter labellum fringe. *C. harringtoniae* is also similar to *C. christineae*, but differs in its sickly sweet odour, its pink floral colour, somewhat broader lateral sepals and labellum, and its occurrence in wet peaty soils.

There are small-flowered members of the *Caladenia patersonii* complex in South Australia and Victoria that resemble *C. harringtoniae* (e.g. *C. rosella* G.W. Carr) in the size of their flowers and their short labellum fringe, but these taxa differ in their darker more glandular sepals and petals, their shorter squat labellum, and thicker clubbed labellum fringe segments. We have no data on how the tepals of these plants are held when fresh, nor on floral odour.

Caladenia heberleana* Hopper & A.P. Br., *sp. nov.

A speciebus ceteris gregis *Caladenia huegelii* H. G. Reichb. petalis sepilisque plerumque dilutoluteis vartia bilibus suffusionibus hebetato-marroninis, deflexis cum clavis longis angustis cernuis, sepalis lateralibus 4–9.5 cm longis, 3–6 mm latis cum clavis diluto-aureo-brunneis 25–75 mm longis, petalis 4.2–8.5 cm longis, 2–4 mm latis cum clavis pallido-aureo-brunneis 20–52 mm longis, labello 17–26 mm longo, 10–15 mm lato, lamina basali alba cum lineis soseis radiantibus, labelli fimbria segmentis gracilibus acutis, ad 9 mm longis, albarum, irregulariter maculatis cum roseis ad marroninis differt.

Typus: Hassell National Park, c. 29 km west-north-west of Sandalwood Road on Hassell Highway, 34°40'S, 118°29'E, Western Australia, 6 October 1987, S.D. Hopper 6195 (*holo:* PERTH 01751581; *iso:* AD!, CBG!, K!, MEL).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 95 (1992) and rev. 2nd edn with suppl., p. 95 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 8–20 cm x 5–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–45 cm tall. *Flowers* 1 or 2(3), c. 6–12 cm across, predominantly pale yellow with variable suffusions, lines and spots of red maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/6–1/5, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 20–65 mm long on dorsal sepal, 20–75 mm long on lateral sepals, 20–52 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4.5–10 cm x 2.5–3 mm. *Lateral sepals* obliquely spreading and downcurved, 4–10 cm x 3–6 mm. *Petals* spreading then obliquely downcurved, 4–8.5 cm x 2–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white, occasionally with

faint pink to red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 1.5–2.5 mm wide; lamina linear-cordate to cordate in outline when flattened, 17–26 x 10–15 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear pale maroon to cream (sometimes white-tipped) calli to 9 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3 the length of the labellum, dark maroon, becoming cream on basal lamina, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 15–20 x 9–12 mm, broadly winged, creamy yellow with pale maroon-pink blotches. *Anther* c. 3–4 x 3–4 mm, greenish yellow. *Pollinia* c. 3–4 mm long, yellow. *Stigma* c. 4 mm wide, yellow-fawn. *Capsule* not seen. (Figure 12H–M)

Selected specimens examined. WESTERN AUSTRALIA: Dog Rock, 13 km SW of Peak Charles, Peak Charles National Park, 32°58'S, 121°04'E, 26 Sep. 1985, A. Brown 236 (PERTH 00905429); edge of road leading to Duke Orleans Bay, 5 km from sea, Esperance, 1 Sep. 1977, A.J. Harrington s.n. (PERTH 00307920); 6 km NE of Albany, S boundary of Allambie Cemetery, 35°00'S, 117°55'E, 30 Sep. 1983, S.D. Hopper 3409 (AD, CBG, K, PERTH 00330426); 2 km SE of Tenterden, Nature Reserve, 9 km SSE of Cranbrook, 34°22'S, 117°34'E, 7 Oct. 1983, S.D. Hopper 3499 (PERTH 00254118); 200 m W of Bremer Bay Caravan Park, 2 km S of Bremer Bay, 34°25'S, 119°23'E, 6 Oct. 1984, S.D. Hopper 4228 (PERTH 00254967); 11.3 km S of Mettlers Rd on Cape Riche Rd, 8 km W of Cape Riche, 34°37'S, 118°42'E, 6 Oct. 1984, S.D. Hopper 4244 (PERTH 00254975); truck bay, 1.1 km N of Gibson on Coolgardie–Esperance highway, 33°39'S, 121°49'E, 9 Oct. 1985, S.D. Hopper 4690 (PERTH 00908576); West Mt Barren in the Fitzgerald River National Park, 34°13'S, 119°26'E, 3 Oct. 90, S.D. Hopper 7882 (PERTH 1828827); 3.5 miles [5.4 km] E of Manjimup on Manjimup–Mount Barker road, 9 Oct. 1972, G.J. & B.J. Keighery s.n. (PERTH 00927643).

Distribution and habitat. Occurs from Albany and the Stirling Range eastwards in a narrow coastal strip to east of Esperance. Grows in a range of habitats, including Jarrah/Marri woodland, sheoak (*Allocasuarina fraseriana*)/Albany Blackbutt (*Eucalyptus staeri*) low woodland, *Eucalyptus decipiens* open mallee heath, and in scrub and heath on granite outcrops. Soils are usually sandy. (Figure 13A)

Flowering period. September to October.

Etymology. Named after Mr Ronald J. Heberle (1913–) of Albany, fisherman and dedicated orchid enthusiast and photographer, who has an exceptional knowledge of the orchids of the south-west, and has brought to our attention numerous unnamed taxa. Ron has accompanied us on several field trips in search of orchids, and has assisted our research in many other ways.

Notes. A common species of the south coast and a little inland. *Caladenia heberleana* has been considered to be a natural hybrid of *C. longicauda* and *C. huegelii* sens. lat. due to its elongate osmophores and pale colouration (e.g. Hoffman & Brown 1984: 111). However, extensive population studies by Ron Heberle and ourselves have shown that *C. heberleana* occurs in numerous large pure populations. Thus it is clearly a species in its own right.

The nearest relative of *Caladenia heberleana* appears to be *C. lorea*, which differs in its less swollen scarcely tumescent osmophores, and in the basal labellum lamina pinkish-white rather than white, with more prominent radiating stripes. *C. lorea* also occurs in the northern sandplains, usually in winter-

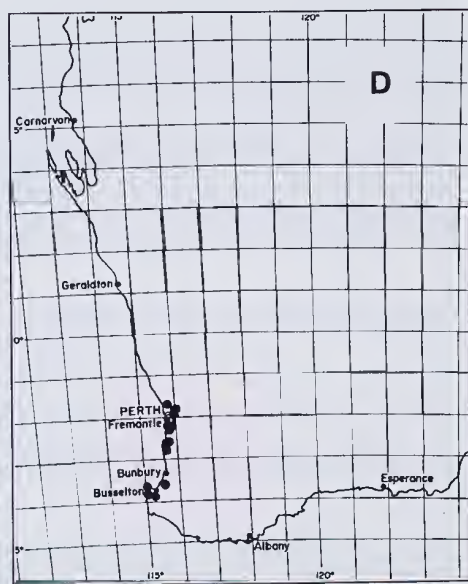
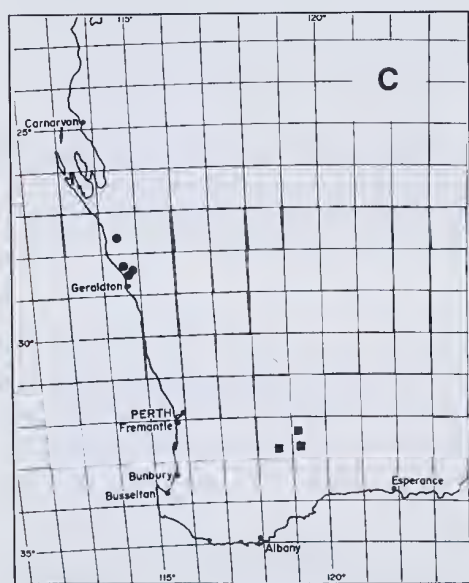
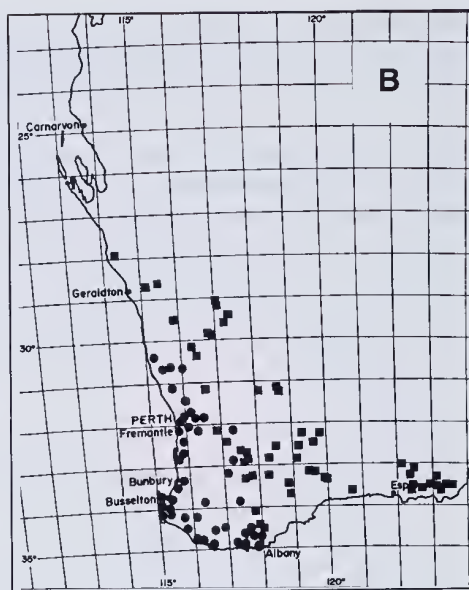
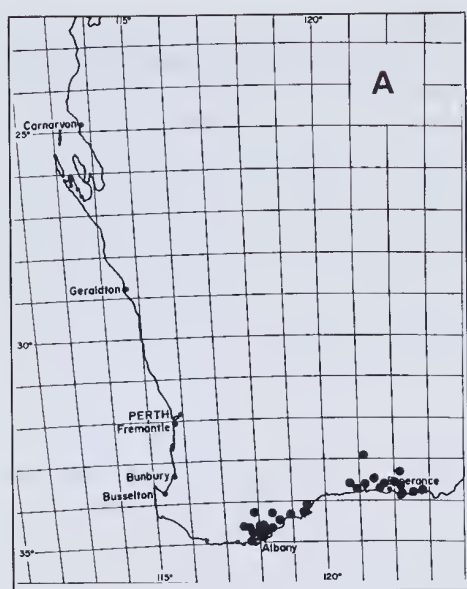


Figure 13. Distribution maps. A – *Caladenia heberleana*; B – *C. hirta* subsp. *hirta* ● and *C. hirta* subsp. *rosea* ■ ; C – *C. hoffmanii* subsp. *hoffmanii* ● and *C. hoffmanii* subsp. *graniticola* ■ ; D – *C. huegelii*.

wet habitats. Thus, *C. heberleana* and *C. lorea* are a good example of a southern sandplain-northern sandplain species pair as seen in many other south-west genera (e.g. the kangaroo paws *Anigozanthos rufus* and *A. pulcherrimus*). *C. heberleana* shows considerable variation in the size of its flowers. Some populations are consistently small while others are large, and may warrant taxonomic recognition following further research.

***Caladenia hirta* Lindl.**, in *Edwards's Bot. Reg.* 1–23: Swan River Append. Iii (1840). *Type*: Vasse River, *Mrs Molloy s.n.* (lecto: K-L photo seen, *fide* George (1971: 171)). *Excluded syntype*: Swan River, 1839, *J. Drummond s.n.* (Figure 87) BM *n.v.*, FL *n.v.* K photo seen, Figure 86).

Plant solitary or in loose to dense clumps. *Leaf* erect or horizontally spreading, broadly linear, 4–20 cm x 5–20 mm, pale green. *Scape* 10–60 cm tall. *Flowers* 1–6, c. 2–5 cm across, white with occasional pink suffusions, or pink to rose pink; floral odour absent. *Sepals and petals* stiffly held, broadly to narrowly lanceolate, gradually narrowing to a brownish-fawn densely glandular shortly acuminate apex lacking a tumescent osmophore; glandular hairs consisting of minute globular sessile glandular cells becoming densely packed towards apex. *Dorsal sepal* erect and curving forward closely appressed to column, 1.5–3.5 cm x 2.5–3.5 mm. *Lateral sepals* spreading or arching outwards, often with obliquely downcurved apices, 1.5–3.7 cm x 3–7 mm. *Petals* spreading or arching outwards, 1.0–3.5 cm x 2–4 mm. *Labellum* obscurely 3-lobed, uniformly coloured except occasional pink suffusions or pale radiating stripes, stiffly articulate on a claw c. 1.5–2 mm wide; lamina linear-rhomboidal in outline when flattened, 10–20 x 5–8 mm, basal 2/5 curving from erect to horizontal, middle 2/5 nearly horizontal, apical 1/5 sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli; lateral lobes erect with entire margins within 5–8 mm of the claw, becoming serrate with slender acuminate narrowly linear white with pink-tipped calli to 1 mm long which are even in size (not decrescent) near midlobe; midlobe margins with short narrow forward-facing acuminate or obtuse calli decrescent, often uniting and broader, towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, pink, base white, golf stick-shaped, the longest c. 1 mm tall, decrescent towards apex and becoming sessile. *Column* 9–15 x 5–6 mm, narrowly winged, cream to pink with dark pink blotches. *Anther* c. 2–3 x 2–3 mm, greenish yellow to pink. *Pollinia* c. 2–3 mm long, yellow. *Stigma* c. 2–3.5 mm wide, creamy yellow-green to pink. *Capsule* not seen.

Distribution and habitat. Widespread between Paynes Find and Israelite Bay. Occurs in coastal woodlands and forest areas, inland mallee woodlands, granite outcrops and salt lake margins. Soils vary from deep sands to sandy clays and heavy lateritic loams.

Flowering period. June to November.

Notes. A widespread and common species with two subspecies. In drier inland areas *Caladenia hirta* subsp. *rosea* has small dark pink flowers, a clump forming habit and an early flowering period, while near the coast and in high rainfall areas of the lower south-west *C. hirta* subsp. *hirta* has larger paler flowers and occurs as scattered individuals. The two taxa rarely overlap in their distribution. Both subspecies hybridize with *C. longicauda* to produce *C. x suffusa*.

Key to subspecies of *Caladenia hirta*

1. Flowers pale creamy-pink, with sepals and petals 2–4 cm long.
 Leaf 6–20 cm long subsp. **hirta**
- 1: Flowers rose-pink, with sepals and petals 1–2 cm long.

Leaf 4–10 cm long subsp. *rosea*

Caladenia hirta* Lindl. subsp. *hirta

Caladenia tenuis Fitzg., *Gard. Chron.* (new ser.) 17: 461 (1882). Type: Saint Werburgh's Chapel [just south of Mount Barker], Western Australia, *R.D. Fitzgerald s.n.* (holo: BM!).

Illustrations. E. Pelloe, *West Australian Orchids*, frontispiece colour plate no. 11 (1930); R. Erickson, *Orchids of the West*, 2nd edn, plate 29 No. 16 (1965); W. Nicholls, *Orchids of Australia*, plate 233a (1969); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 12 right photo (undated); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 16B (1984); E. Bennett, *The Bushland Plants of Kings Park Western Australia*, figure 222 (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 67 (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 140 (1992) and rev. 2nd edn with suppl., p. 140 (1998).

Plant usually solitary. *Leaf* 6–20 cm long. *Scape* 10–60 cm tall. *Flowers* 1–6, c. 3–5 cm across, white with occasional pink suffusions. *Sepals* 1.8–3.5 cm long. *Petals* 1.7–3.5 cm long. *Labellum lamina* 12–20 x 6–8 mm. (Figures 14A–P)

Selected specimens examined. WESTERN AUSTRALIA: Muirs Highway, c. 200 m W of Thompsons Rd, 34°27'S, 116°38'E, 16 Oct. 1986, *A. Brown* 492 (PERTH 01697919); Kewdale, 31°58'S, 115°58'E, 7 Sep. 1976, *R. Coveny* 8216 (PERTH 00262188); New Norcia, towards Victoria Plains, 29 Aug. 1901, *L. Diels s.n.* (PERTH 00324132); Quairading, 11 Sep. 1931, *Edmondson s.n.* (PERTH 00324582); S of Yallingup, 8 Oct. 1967, *A.S. George* 9206 (PERTH 00324094); 6 km SSE of Gracetown, 7 km NW of Margaret River, 33°55'S, 115°00'E, 9 Oct. 1984, *S.D. Hopper* 4292 (PERTH 00261238); 37.3 km S of Mandurah on the Old Coast Rd, 10.7 km N of Preston Beach Rd, 32°50'S, 115°41'E, 9 Sep. 1985, *S.D. Hopper* 4492 (PERTH 00908614); S verge of Muirs Highway, 0.2 km W of Thompson Rd at the "MJ60" sign, 37 km WNW of Rocky Gully, 34°27'S, 116°38'E, 16 Oct. 1986, *S.D. Hopper* 5754 (PERTH 01198785); Walpole, Oct. 1961, *W. Rogerson* 103 (PERTH 00324140); Yarloop, Sep. 1941, *E. Scouter s.n.* (PERTH 00262196); Walpole, 7 Oct. 1973, *E. Wittwer* W.1161 (PERTH 00325066).

Distribution and habitat. Found between Arrowsmith and Albany in *Banksia*, Tuart and Peppermint woodlands, Jarrah forest and swamp margins. Soils vary from deep sand to heavy lateritic loam. (Figure 13B)

Flowering period. September to November.

Notes. A common subspecies of the higher rainfall areas of south-west Western Australia. Although some intergradation does occur with *Caladenia hirta* subsp. *rosea* along the eastern and northern edges of its distribution, *C. hirta* subsp. *hirta* characteristically has more flowers per scape, larger paler-coloured flowers to 5 cm across, taller scapes, a longer leaf and a later flowering period.

***Caladenia hirta* subsp. *rosea* Hopper & A.P. Br., subsp. nov.**

A subspecies typica floribus roseis parvioribus differt.

Typus: Mt Hampton Nature Reserve, east boundary, 72 km north-east of Narembreen, 81 km south-east of Merredin, 31°45'S, 119°04'E, Western Australia, 5 September 1984, *S.D. Hopper* 4058 (holo:

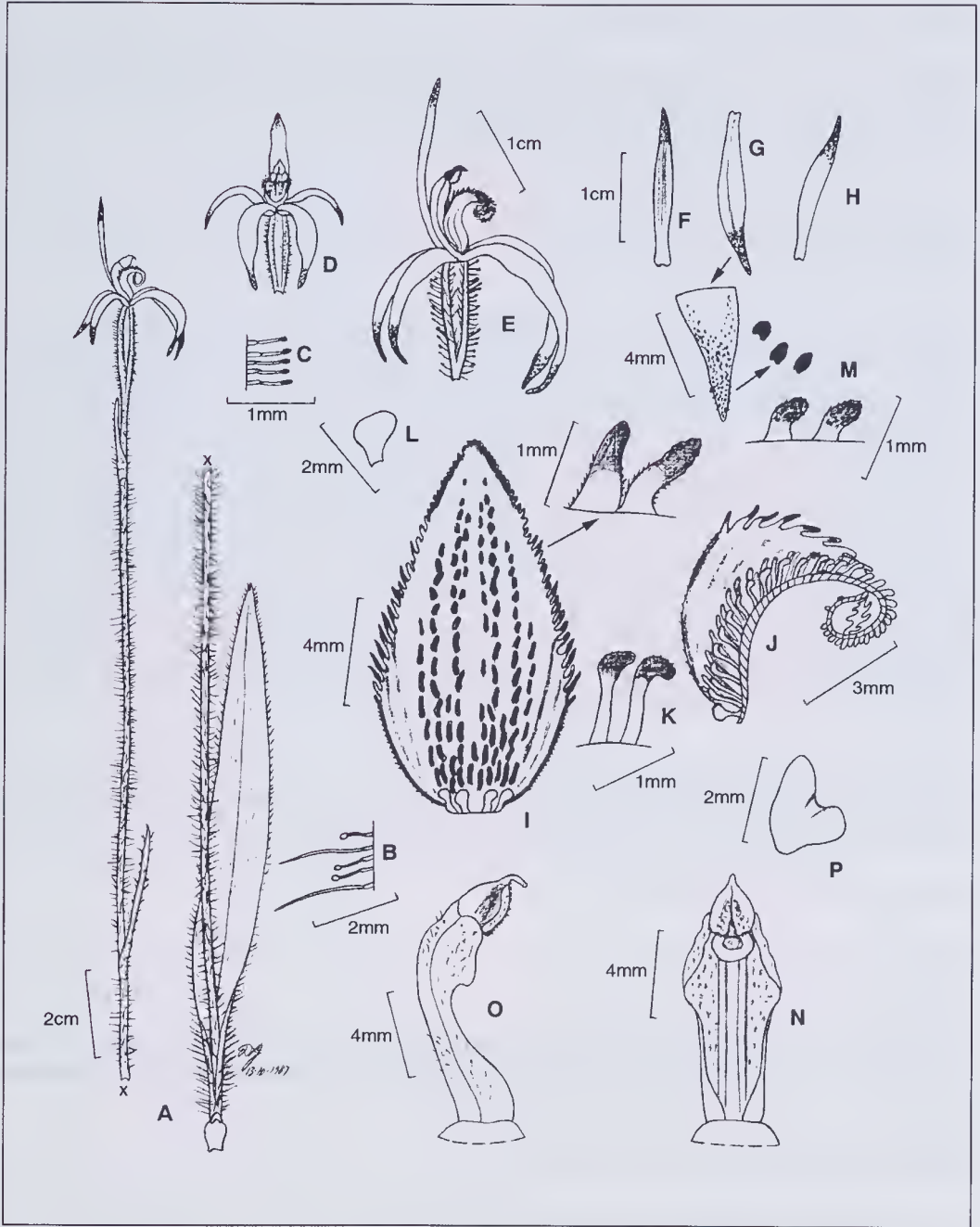


Figure 14. *Caladenia hirta* subsp. *hirta* from the Lake Muir area, M.E. Richards s.n. A – plant; B – hairs on lower scape; C – hairs on upper scape; D – flower from front; E – flower from side; F – dorsal sepal from front; G – lateral sepal from front; H – petal from front; I – flattened labellum from above; J – longitudinally sectioned labellum from side; K – near basal labellum lamina calli; L – basal labellum lamina callus; M – labellum lamina calli near apex; N – column from front; O – column from side; P – pollinia. Drawn by D.L. Jones.

PERTH 00260827; *iso*: AD!, CBG!, K!).

Illustrations. W. Nicholls, *Orchids of Australia*, plate 233, unnumbered pink flower to the right of a (1969); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 166 (1984), 2nd edn, p. 141 (1992) and rev. 2nd edn with suppl., p. 141 (1998).

Plant usually clumped. *Leaf* 4–10 cm long. *Scape* 10–25 cm tall. *Flowers* 1–3, c. 2–3 cm across, pink to rose pink. *Sepals* 1.5–2.5 cm long. *Petals* 1.0–2.2 cm long. *Labellum lamina* 10–15 x 5–8 mm. (Figures 12N–S)

Selected specimens examined. WESTERN AUSTRALIA: Great Northern Highway c. 30 km WSW of Paynes Find, 29°20'S, 117°23'E, 23 Aug. 1988, A. Brown 836 (PERTH 01195069); Oldfield River, Ravensthorpe–Esperance road, 10 Sep. 1971, A.S. George 10990 (PERTH 00325562); Stirling Range, Oct. 1920, B.T. Goadby 1625 (PERTH 00324655); 3 km SE of Karlgarin Hill, 30 km W of Hyden on Kondinin–Hyden road, 32°30'S, 118°34'E, 16 Aug. 1978, S.D. Hopper 1055 (PERTH 00261696); Karomin Hill, 12 km N of Nungarin, 16 km ENE of Kununoppin, 31°05'S, 118°05'E, 31 Aug. 1984, S.D. Hopper 4000 (AD, CBG, PERTH 00261262); King Rocks, 30 km NE of Hyden, 75 km SE of Narembeen, 32°19'S, 119°09'E, 5 Sep. 1984, S.D. Hopper 4072 (PERTH 00261319); Pallarup Rock Nature Reserve, Pallarup Rock, 44.5 NNW of Ravensthorpe, 33°15'S, 119°45'E, 6 Sep. 1984, S.D. Hopper 4093 (CBG, PERTH 00261211); Dragon Rock Nature Reserve (No 36128), 31 km N of Newdegate, 32°49'S, 119°02'E, 13 Sep. 1985, S.D. Hopper 4568 (PERTH 00909041); Birdwhistle Rock, c. 27 km ENE of Narrogin, 32°53'S, 117°28'E, 23 Sep. 1988, S.D. Hopper 6768 (PERTH 01667513); Mt Ridley, E of Grass Patch, 20 Aug. 1978, D.R. Voigt 54p.p. (PERTH 00325112); Kalbarri, 3 Aug. 1980, R.C. Wemm 1859 (PERTH 00325104).

Distribution and habitat. Ranges between Kalbarri and Israelite Bay, extending to the western margins of the wheatbelt. Grows often on granite outcrops, on the margins of salt lakes and other areas where soil moisture accumulates. Soils vary from red clay-loams to sands. (Figure 13B)

Flowering period. June to September.

Etymology. Named from the Latin – *roseus* (rose coloured or reddening), alluding to the floral colouration.

Notes. A particularly common and widespread subspecies of the wheatbelt and the adjacent goldfields and pastoral country. *Caladenia hirta* subsp. *rosea* is readily distinguished from the nominate subspecies by its pink colouration, clump forming habit, smaller stature and earlier flowering.

Caladenia hoffmanii Hopper & A.P. Br., *sp. nov.*

A *Caladenia corynephora* A. S. George petalis sepalisque cum clavis minus carnosus, labello aliquantum parviore, 12–17 mm longo et 6–8 mm lato, sine apice glandulare aureo-brunneo, labelli lamina dimidio basali alba cum lineis marroninis radiantibus et prope margines cum suffusionibus marroninis, labelli fimbria brevior ad 5 mm longa, et callis parvioribus in zonis angustioribus centralibus ad 3 mm latis dispositis differt.

Typus: Morseby Range, Western Australia, September 1984, K. Miller *s.n.* (*holo*: PERTH 00899623; *iso*: AD!, CBG!, MEL!).

Plant solitary. *Leaf* erect, linear, 8–15 cm x 5–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 12–30 cm tall. *Flowers* 1(2), c. 3–5 cm across, predominantly cream to yellowish-green with variable suffusions, lines and spots of dull pinkish maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/3–1/2, then abruptly narrowing with slightly to strongly upturned/incurved margins on an acuminate apical osmophore; osmophore scarcely tumescent, 3–10 mm long in sepals, 2–10 mm long in petals, light brown to yellow, consisting of minute dark brown densely packed globular to shortly barrel-shaped sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 2–3.7 cm x 1.5–3.0 mm. *Lateral sepals* spreading obliquely downward and laterally falcate and sometimes crossed in front at the apex, 2–3.5 cm x 3–5 mm. *Petals* spreading horizontally to obliquely downward, 1.7–3.0 cm x 2–3 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white in basal 2/3, sometimes with a greenish suffusion near fringe, lacking radiating stripes or with prominent to inconspicuous radiating stripes and maroon suffusions near the margins subtending the longer marginal calli, terminating in a uniformly dark maroon downcurved apex, stiffly articulate on a claw c. 1.5–3 mm wide; lamina linear-cordate (rarely cordate) in outline when flattened, 12–20 x 6–9 mm, with maroon apical midlobe one third the length, evenly curved in lateral view with basal half from erect to horizontal and apical half gradually downcurved to a vertical apex, margins at widest point scarcely curved upwards and terminated by obliquely to vertically ascending margins and calli; lateral lobes erect with entire margins within 3–4 mm of claw, then becoming fimbriate with slender acuminate linear dark maroon sometimes white-tipped calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked incudiform calli decrescent towards the apex. *Lamina calli* in 4 close rows extending at least 4/5 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped with enlarged tops densely and minutely papillate, the longest c. 3 mm tall, decrescent towards apex and becoming sessile. *Column* 10–17 x 5–8 mm, broadly winged, creamy yellow to green with red-pink blotches. *Anther* c. 1.5–3 x 1.5–2.5 mm, yellowish green and dark maroon. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 1.5–2.5 mm wide, green. *Capsule* not seen.

Distribution and habitat. Occurs between the lower Murchison River and Geraldton, growing beneath dense heath in clay loams on hillslopes and near breakaways, and some 600 km to the south-east near Pingaring, growing beneath tall shrubs and Rock Oaks on and around granite outcrops.

Flowering period. August to October.

Etymology. Named after Mr Noel Hoffman (1931–), retired primary school headmaster and co-author of *Orchids of South-West Australia*, who made some of the earliest orchid collections from the Murchison River area where *Caladenia hoffmanii* grows, and who has contributed greatly to knowledge of and interest in the Western Australian orchids.

Notes. A rare species currently declared as Rare Flora (Hopper *et al.* 1990, Brown *et al.* 1998) and remarkable in the wide disjunction of its two subspecies.

Caladenia hoffmanii is easily recognized and has no close relatives, the nearest appearing to be *C. corynephora*, a summer flowering south-coast endemic, from which *C. hoffmanii* differs in its less tumescent osmophores, its somewhat smaller labellum lacking a glandular golden brown apex, the basal half of the labellum lamina predominantly white, and its labellum with shorter marginal calli and smaller lamina calli.

Two subspecies are recognized, both of which are declared as Rare Flora and one of which (*Caladenia hoffmanii* subsp. *hoffmanii*) occasionally hybridizes with *C. longicauda* subsp. *borealis*.

Key to subspecies of *Caladenia hoffmanii*

1. Labellum lamina usually 12–14 mm long, linear-cordate to cordate in outline when flattened, with the maroon apical midlobe narrowly triangular and acute; lamina calli decreasing in length evenly from base to near apex, the longest to 1.5 mm tall.
Column 10–13 mm tall subsp. **hoffmanii**
- 1: Labellum lamina 15–20 mm long, linear-cordate (never cordate) in outline when flattened, with the maroon apical midlobe narrowly triangular to almost parallel sided with apex obtuse and mucronate, rarely acute; lamina calli decreasing in length abruptly beyond the basal cluster towards apex, the longest to 3 mm tall.
Column 14–17 mm tall subsp. **graniticola**

Caladenia hoffmanii Hopper & A.P. Br. subsp. **hoffmanii**

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 124, [as *C. hoffmanii*] (1992), rev. 2nd edn with suppl., p. 124 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 34 (1998).

Dorsal sepal 2–2.8 cm long. *Lateral sepals* 2–2.8 cm x 3–3.5 mm. *Petals* 1.7–2.5 cm x 2–2.5 mm. *Labellum lamina* linear-cordate to cordate in outline when flattened, 12–14 mm long, with maroon apical midlobe narrowly triangular and acute. *Lamina calli* decreasing in length evenly from base to near apex, the longest to 1.5 mm tall. *Column* 10–13 x 5–6 mm. *Anther* c. 1.5–2 x 1.5–2 mm. (Figure 12T–Z)

Selected specimens examined. WESTERN AUSTRALIA: Moorsby Range, 23 Aug. 1985, *A. Brown s.n.* (PERTH 00905402); near Northampton, 25 Aug. 1982, *A. Brown s.n.* (PERTH 00267538); near Geraldton, 23 Aug. 1984, *A. Brown s.n.* (PERTH 00267554); Murchison River Gorge, 7 Sep. 1966, *A.S. George s.n.* (PERTH 00267546); NE of Geraldton, 27 Aug. 1980, *G.J. Keighery* 3328 (PERTH 00330841); Murchison River, Sep. 1966, *J. Tonkinson s.n.* (PERTH 00267929).

Distribution and habitat. Ranges from the lower Murchison River and Geraldton, growing beneath dense heath in clay loams on hillslopes and near breakaways. (Figure 13C)

Flowering period. August to September.

Notes. *Caladenia hoffmanii* subsp. *hoffmanii* differs from *C. hoffmanii* subsp. *graniticola* in its smaller flowers with shorter basal calli and column, its earlier flowering period, and its more northerly distribution in clay loams near lateritic sandstone breakaways.

Caladenia hoffmanii subsp. **graniticola** Hopper & A.P. Br., subsp. nov.

A subspecie typica floribus majorioribus et labello callorum robustorum differt.

Typus: Pingaring, Western Australia, 1985, K. White sn. (*holo*: PERTH 00308056).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora plate 56 (1990) [as *Caladenia* sp. (Moresby Range) G.J. Keighery 3328, Hoffman's Spider Orchid]; N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 419 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 157 (1998).

Dorsal sepal 2.5–3.5 cm long. *Lateral sepals* 2.2–3.2 cm x 3–5 mm. *Petals* 2.0–3.0 cm x 2.5–3.0 mm. *Labellum lamina* linear-cordate (never cordate) in outline when flattened, 15–20 mm long, with maroon apical midlobe narrowly triangular to almost parallel sided with apex obtuse and mucronate, rarely acute. *Lamina calli* decreasing in length abruptly beyond the basal cluster towards apex, the longest to 3 mm tall. *Column* 14–17 x 5–8 mm. *Anther* c. 2.5–3.0 x 2.5–3.0 mm.

Selected specimen examined. WESTERN AUSTRALIA: near Newdegate, 13 Sep. 1985, S.D. Hopper 4569 (PERTH 00909033).

Distribution and habitat. In the Pingaring–Newdegate area of the south-central wheatbelt, growing beneath tall shrubs and Rock Oaks on and around granite outcrops. (Figure 13C)

Flowering period. September to October.

Etymology. Named from the rock granite and Latin suffix *-cola* – dweller, alluding to the distinctive habitat occupied by the subspecies.

Notes. *Caladenia hoffmanii* subsp. *graniticola* is declared as Rare Flora. The taxon was first brought to our attention by Mrs K. White in 1984. It remains a rare taxon, recorded from only four granite outcrops. The labellum is distinctive in shape when flattened, and basal calli and column are larger than in *C. hoffmanii* subsp. *hoffmanii*.

Caladenia huegelii H.G. Reichb., *Beitr. Syst. Pflanzenk.* 66 (1871). *Type*: King George Sound (?), Huegel s.n. (*lecto*: W!, *fide* M. Clements (1989: 26)). *Excluded syntype*: Swan River, J. Drummond 439 (Kn.v., W!).

Illustrations. W. Nicholls, Orchids of Australia, plate 253 [as *Caladenia* species] (1969); S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora plate 52, [as *Caladenia* sp. (Coastal Plain)] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 112 [as *Caladenia* sp.] (1984), 2nd edn, p. 107 (1992) and rev. 2nd edn with suppl., p. 107 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 115 (1998).

Plant solitary, rarely in loose clumps. *Leaf* erect, linear, 10–18 cm x 7–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–60 cm tall. *Flowers* 1 or 2(3), c. 7–10 cm across, predominantly pale greenish-yellow with variable suffusions, lines and spots of red maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 12–40 mm long in dorsal sepal, 6–40 mm long in lateral sepals, absent from petals, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4.5–12 cm x 2.5–4 mm.

Lateral sepals obliquely spreading downwards, 4–12 cm x 4–7 mm. *Petals* spreading sometimes obliquely downcurved, 3–6 cm x 3–5 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, cream, becoming greenish towards fringe, with pale red radiating stripes, terminating in a uniformly dark maroon recurved apex, the latter prominently channelled and infundibular when viewed from the front, stiffly articulated on a claw c. 1.5–2.5 mm wide; lamina linear-cordate to cordate in outline, 23–30 x 13–20 mm, with dark midlobe almost parallel-sided and obtuse with a shortly acute apex when flattened, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear sometimes bifurcate greenish-cream suffused maroon usually white-tipped calli to 15 mm long which are abruptly decrescent near midlobe; midlobe margins with short (to 3 mm) slender slightly forward-facing obtuse (rarely acute) sometimes hooked or bifurcate dark maroon calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, becoming cream towards the base of the lamina, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 17–22 x 10–14 mm, broadly winged, greenish yellow with pale maroon blotches. *Anther* c. 5 x 4 mm, greenish yellow with maroon suffusions. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 3–4 mm wide, yellow-fawn. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: Thornlie, 7 Sep. 1977, A.S. George 14856 (PERTH 00255971); Yallingup, 8 Oct. 1967, A.S. George 9207 (CBG, PERTH 00256404); Jandakot, 7 Sep. 1958, A.S. George s.n. (PERTH 00256021); Leeming, 21 Sep. 1983, S.D. Hopper 3397 (PERTH 00255955); Canningvale, 26 Sep. 1983, S.D. Hopper 3400 (PERTH 00256463); near Mt Yates, 21 Sep. 1983, G.J. Keighery 6700 (PERTH 00309869); Pinjarra, Sep. 1925, State School s.n. (PERTH 00327492); Queens Park, Sep. 1912, M.E. Wood B.2319 (PERTH 00255939).

Distribution and habitat. A species of scattered occurrence in *Banksia*, Jarrah and Marri woodlands from just north of Perth to the Margaret River area, usually within 20 km of the coast. Grows amongst dense low shrubs in deep sandy soils, flowering in greater profusion following summer fire. (Figure 13D)

Flowering period. September to October.

Notes. A rare species (Declared Rare), probably once common on the coastal plain but due to extensive clearing now confined to scattered small areas of remnant bushland.

Since its description by Reichenbach in 1871 a good deal of confusion has surrounded the correct identity of *Caladenia huegelii*. It has been regarded by most authors as a widespread, variable species and as such has embraced a number of related but nevertheless distinct taxa including *C. pectinata* and *C. ferruginea*. The type sheet contains three distinct taxa, including *C. ensata*. George (1971) selected a lectotype from one of the remaining two, remarking that it “best agrees with Reichenbach’s description” of the species. However, the original description, published in the middle of a paragraph, appears to more closely match the third specimen found on the left side of the sheet, especially the reference to an oblong labellum, toothed at the front and with a rounded, shallowly notched end. Hopper & Clements (1989) recognized this and proposed the specimen on the left (labelled as the syntype) be re-designated as the lectotype of *C. huegelii*. This was recorded on a determinavit placed on the type sheet by the senior author on 17 April 1991. The specimen previously labelled as lectotype is described herein as *C. paludosa*.

The location of King George Sound (actually “K.G.S. Hugel”) on the type sheet is given immediately below the specimen of *Caladenia ensata* and may be accurate for that specimen (given

that the species occurs in the Albany area). However, the two other specimens on the type sheet, including the lectotype, are of species (*C. huegelii* s. str. and *C. paludosa*) that are confined to the west coast and have not been recorded from the Albany area. Moreover, none of the three taxa on the type sheet flower into January when Huegel visited King George Sound (i.e. 1–12 January 1834 – Diels 1906). It is most unlikely, therefore, that Huegel collected any of these specimens from Albany. His visit to Perth, preceding that to Albany, was from 17 November to 19 December. Potentially, some late-flowering *C. paludosa* might have been collected at this time. However, typical *C. huegelii* is finished flowering by mid-October in the Perth area and, again, could not have been collected in the wild by Huegel.

The origin of the specimens on the type sheet is therefore enigmatic. Possibly, they were provided to Huegel by another collector such as Drummond. Alternatively, they were mistakenly bundled together and attributed to Huegel during subsequent shipping and curation of collections to Vienna prior to Reichenbach naming the species. Further research is needed.

Caladenia infundibularis A.S. George, *Nuytsia* 5 (1): 55–56, f. I, E–I (1984). *Type*: near scenic drive turnoff, Augusta–Cape Leeuwin road, Western Australia, 16 October 1973, A.S. George 11727 (*holo*: PERTH 01136291; *iso*: CANB!).

Illustrations. A.S. George, *Nuytsia* 5(1), p. 54 E–I (1984). N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 114 [as *Caladenia* sp.] (1984), 2nd edn, p. 113 (1992), rev. 2nd edn with suppl., p. 113 (1998).

Plant solitary, rarely in loose clumps. *Leaf* erect, linear, 10–26 cm x 8–14 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–45 cm tall. *Flowers* 1 or 2(3), c. 6–8 cm across, predominantly green to yellowish-green (occasionally white on central basal labellum lamina) with variable suffusions, lines and spots of dark maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 6–15 mm long in dorsal sepal, 7–15 mm long in lateral sepals, absent from petals, light golden brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–5.5 cm x 2.0–3.0 mm. *Lateral sepals* obliquely downcurved, 3.5–6.5 cm x 4.0–6.0 mm. *Petals* horizontal to obliquely downcurved, 2.7–3.8 cm x 3.0–5.0 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured (rarely 3-coloured), green or greenish-yellow, sometimes white near central calli, occasionally with inconspicuous radiating greenish stripes, terminating in a uniformly dark maroon recurved apex usually occupying 1/2–3/4 the midlobe, stiffly articulate on a claw c. 1–2 mm wide; lamina linear-cordate to cordate or triangular in outline when flattened, 20–24 x 11–16 mm, basal quarter curving from erect to oblique, middle 1/2–2/3 slightly curved to horizontal and flattened laterally, apical 1/4–1/12 sharply downcurved with incurved margins so as to be channelled medially, almost forming a funnel, margins at widest point scarcely curved upwards and terminated by slightly ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear green to yellowish-green calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending 1/3–1/2 the length of the labellum, yellowish-green, golf stick-shaped, the longest c. 1.5 mm tall, slightly decrescent towards apex. *Column* 13–20 x 8–10 mm, broadly winged, greenish yellow with pale maroon markings. *Anther* c. 4 x 4 mm, yellowish green. *Pollinia* c. 3.0–3.5 mm long, yellow. *Stigma* c. 3.0–3.5 mm wide, dark yellowish brown. *Capsule* not seen. (Figure 15A–F)

Selected specimens examined. WESTERN AUSTRALIA: c. 1 km N of Augusta on the W side of

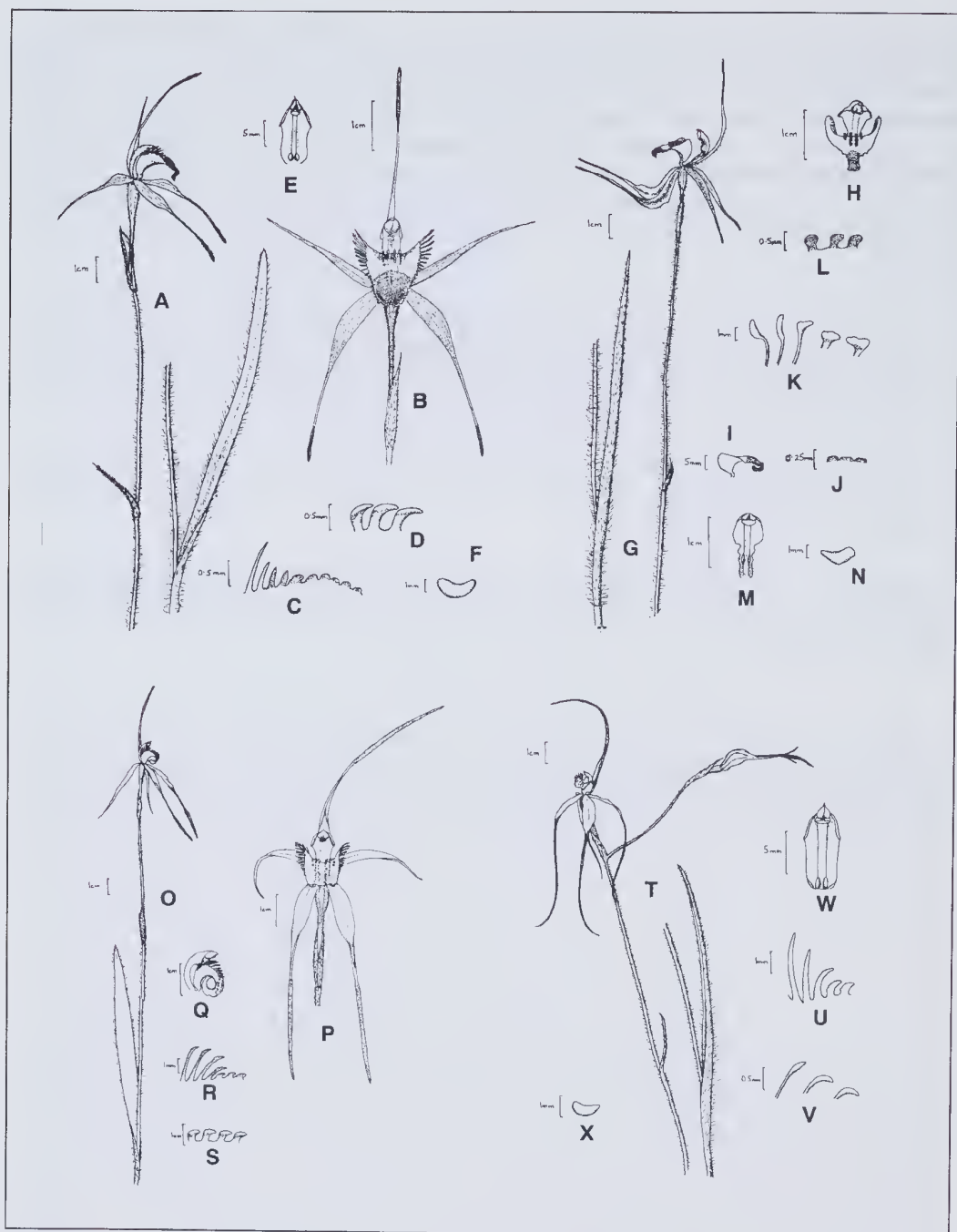


Figure 15 A-F. *Caladenia infundibularis* from the Margaret River area, S.D. Hopper 4288. A - plant; B - flower; C - labellum fringe; D - calli; E - column from front; F - pollinia. G-N. *C. integra* from Mt Bakewell, York, A.S. George s.n. G - plant; H - labellum and column from front; I - labellum from side; J - labellum fringe near apex; K - calli near rear of labellum; L - calli near front of labellum; M - column from front; N - pollinia. O-S. *C. interjacens* from west of Walpole, S.D. Hopper 4261. O - plant; P - flower; Q - labellum and column from side; R - labellum fringe; S - calli. T-X. *Caladenia longicauda* subsp. *longicauda*. Darling Range near Perth, S.D. Hopper 4631. T - plant; U - labellum fringe; V - calli; W - column from front; X - pollinia. Drawn by S.J. Patrick.

Bussell Highway, 34°19'S, 115°09'E, 28 Sep. 1986, A. Brown 442 (CBG, PERTH 00929646); S of Yallingup, 33°39'S, 115°01'E, 8 Oct. 1967, A.S. George 9209 (CBG, PERTH 00265136); 7.5 km W of Carburnup, c. 1 km SE of junction of Wildwood Rd and Abbey Farm Rd, 33°42'S, 115°07'E, 20 Oct., S.D. Hopper 2676 (PERTH 00265071); 4 km NNE of Margaret River, 1 km E of Bussell Highway on Bramley Rd, 33°55'S, 115°05'E, 4 Oct. 1983, S.D. Hopper 3425 (PERTH 00265047); 1.5 km S of Vasse Highway on Scott Rd, 22 km W of Pemberton, 34°24'S, 115°48'E, 8 Oct. 1984, S.D. Hopper 4270 (PERTH 00265055); 4 km W of Alexandra Bridge along Brockman Highway, 34°11'S, 115°09'E, 22 Oct. 1974, S.D. Hopper s.n. (PERTH 00263176); S of Kirup on the South Western Highway, 33°44'S, 115°54'E, 4 Oct. 1991, J. Start s.n. (PERTH 1828495).

Distribution and habitat. Occurs in low coastal heath and mixed Jarrah/Karri forest between the Leeuwin–Naturaliste Ridge and Northcliffe. Soils range from granitic and lateritic loam to deep sand. (Figure 16A)

Flowering period. October to November.

Notes. A recently described species (George 1984) that is often locally common, particularly in coastal areas along the Leeuwin–Naturaliste Ridge. *Caladenia infundibularis* is distantly related to members of the *C. huegelii* complex, but differs in its flattened outward projecting labellum, its short marginal calli on the labellum, and its distinctive yellowish-green colouration. *C. infundibularis* differs from *C. granitora* in its larger flowers with the labellum lamina greenish yellow near the base, and its more westerly distribution, between Northcliffe and Dunsborough.

Caladenia integra E. Coleman, *Victorian Naturalist* 49: 246, f. (1933). *Type:* Tunney, Aurora, Kendenup, Western Australia, September 1930, R. Sandilands & F. Row s.n. (*lecto:* MEL!, *fide* George 1971: 172). *Excluded syntypes:* Tunney, Aurora, Kendenup, Western Australia, 1921, 1931, 1932, R. Sandilands & F. Row s.n. (MEL!).

Illustrations. W. Blackall & B. Grieve, *How to Know Western Australian Wildflowers*, Part 1, p. 94 (1954); R. Erickson, *Orchids of the West*, 2nd edn, frontispiece, 1 (1965); W. Nicholls, *Orchids of Australia*, plate 269 (1969); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 21 bottom left photo (undated); M. Pocock, *Ground Orchids of Australia*, photo 24 (1972); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st edn, p. 128 plate 401 (1973); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 45C (1984); D. Jones, *Native Orchids of Australia*, p. 122, illustration top left (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 68 left (1989); S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, *Western Australia's Endangered Flora*, plate 49 (1990); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 132 (1984), 2nd edn, p. 120 (1992) and rev. 2nd edn with suppl., p. 120 (1998).

Plant solitary, rarely in loose clumps. *Leaf* erect, linear, 15–25 cm x 10–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–50 cm tall. *Flowers* 1 or 2, c. 6–8 cm across, predominantly green to greenish-yellow and red-maroon; floral odour absent. *Sepals and petals* stiffly held, conspicuously marked with red-maroon suffusions and median stripes; osmophore slightly tumescent, 6–15 mm long on dorsal sepal, 5–10 mm long on lateral sepals, absent from petals, yellow or fawn, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* horizontal near base initially in line with the column, then curving outwards, upwards and forwards not as sharply as the curvature of upper column, 4.5–7.0 cm x 2–3 mm, linear in basal third, then abruptly narrowing and filiform below osmophore. *Lateral sepals* splayed forwards and downwards for the first c. 1 cm

then curving inwards and obliquely upwards, 4–6 cm x 3.5–5 mm, base narrowly lunate, then abruptly narrowing as for dorsal sepal. *Petals* usually straight, spreading obliquely downwards and backwards, 3.5–4.5 cm x 2.5–3.5 mm. *Labellum* prominently 3-lobed, 2- or 3-coloured, yellow to yellowish-green, terminating in a uniformly dark purple forward projecting apex, loosely articulate on a claw c. 1.5 mm wide; lamina obtusely hastate, 18–22 x 15–20 mm, with the lateral lobe apices facing outward (rarely curved obliquely forward and somewhat acute), the midlobe 7–12 mm wide, narrowly triangular with a long acute apex (rarely somewhat dilated apically) when flattened, basal third erect, distal 2/3 horizontal, margins at widest point deeply curved upwards and becoming obliquely to vertically ascending; lateral lobes erect with entire proximal margins; midlobe margins entire, rarely becoming shortly dentate with broad slightly forward-facing obtuse simple calli apically. *Lamina calli* densely congested near base, separating apically in a medial band extending at least half the length of the labellum terminating before the dark purple apex, dark purplish-maroon, linear to slightly clavate, the longest c. 5 mm tall, decrescent towards apex and becoming sessile. *Column* 17–24 x 8–10 mm, narrowly winged, wings flat to undulate near base, pale yellow-green with prominent pale maroon blotches. *Anther* c. 3–4 x 3.5 mm, greenish-yellow. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 5 mm wide, dark dull maroon to pale green. *Capsule* not seen. (Figure 15G–N)

Selected specimens examined. WESTERN AUSTRALIA: Pauls Valley, 34°08'S, 117°23'E, 30 Sep. 1930, R. Erickson s.n. (PERTH 00264644); Tutanning Reserve (c. 25 km E of Pingelly), 32°33'S, 117°20'E, 16 Oct. 1964, A.S. George 6449 (PERTH 00264199); Mt Bakewell, York, 31°51'S, 116°45'E, 24 Sep. 1961, A.S. George s.n. (PERTH 00578126); Tenterden Nature Reserve Number 30774, 34°22'S, 117°34'E, 29 Oct. 1990, M.S. Graham MSG299 (PERTH 01609475); near Tower Hill, c. 5.5 km SW from Wagin, 33°20'S, 117°18'E, 12 Oct. 1986, S.D. Hopper 5644 (PERTH 01196146); Birdwhistle Rock, c. 27 km ENE of Narrogin, 32°53'S, 117°28'E, 23 Sep. 1988, S.D. Hopper 6765 (PERTH 01195123); Kendenup, 34°29'S, 117°38'E, 1934, F.W. Rowe s.n. (PERTH 00264121); Murchison River, 23 Sep. 1948, B. Shipway s.n. (PERTH 00264598).

Distribution and habitat. Occurs in isolated populations between Tenterden and Clackline. There is a disjunct occurrence of a smaller-flowered form near Kalbarri where it has not been seen in recent years. Preferred habitat appears to be under dense Rock Oak adjacent to granite outcrops, but it has also been found in open Wandoo woodland. Soils are sandy clays or granitic loams. (Figure 16B)

Flowering period. September to October.

Notes. A rare species of scattered occurrence between Tenterden and Kalbarri. It is a member of the *Caladenia dilatata* complex from which it is easily identified by its entire, rather than fringed labellum margins. Rare hybrids have been found between *C. integra* and *C. falcata* in the Williams area. *C. exstans* is closely related to *C. integra* but differs in its smaller flowers, less obviously falcate sepals, shorter more prominently lobed labellum with shorter golf-stick shaped calli extending into the maroon apex and its more easterly distribution between Esperance and Israelite Bay.

***Caladenia interjacens* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinis *Caladenia huegelii* H.G. Reichb. petalis sepalisque cremeis saepe suffusis pallido-roseis, sepalis lateralibus 5.5–11 cm longis et labello plerumque albedo callis fimbriisque roseis, interdum dimidio apicis atroroseo differt.

Typus: west side of Mandalay beach road, c. 16.7 km south-west of the ranger's house, in Walpole National Park, 34°59'S, 116°33'E, Western Australia, 16 October 1986, S.D. Hopper 5733 (*holo*:

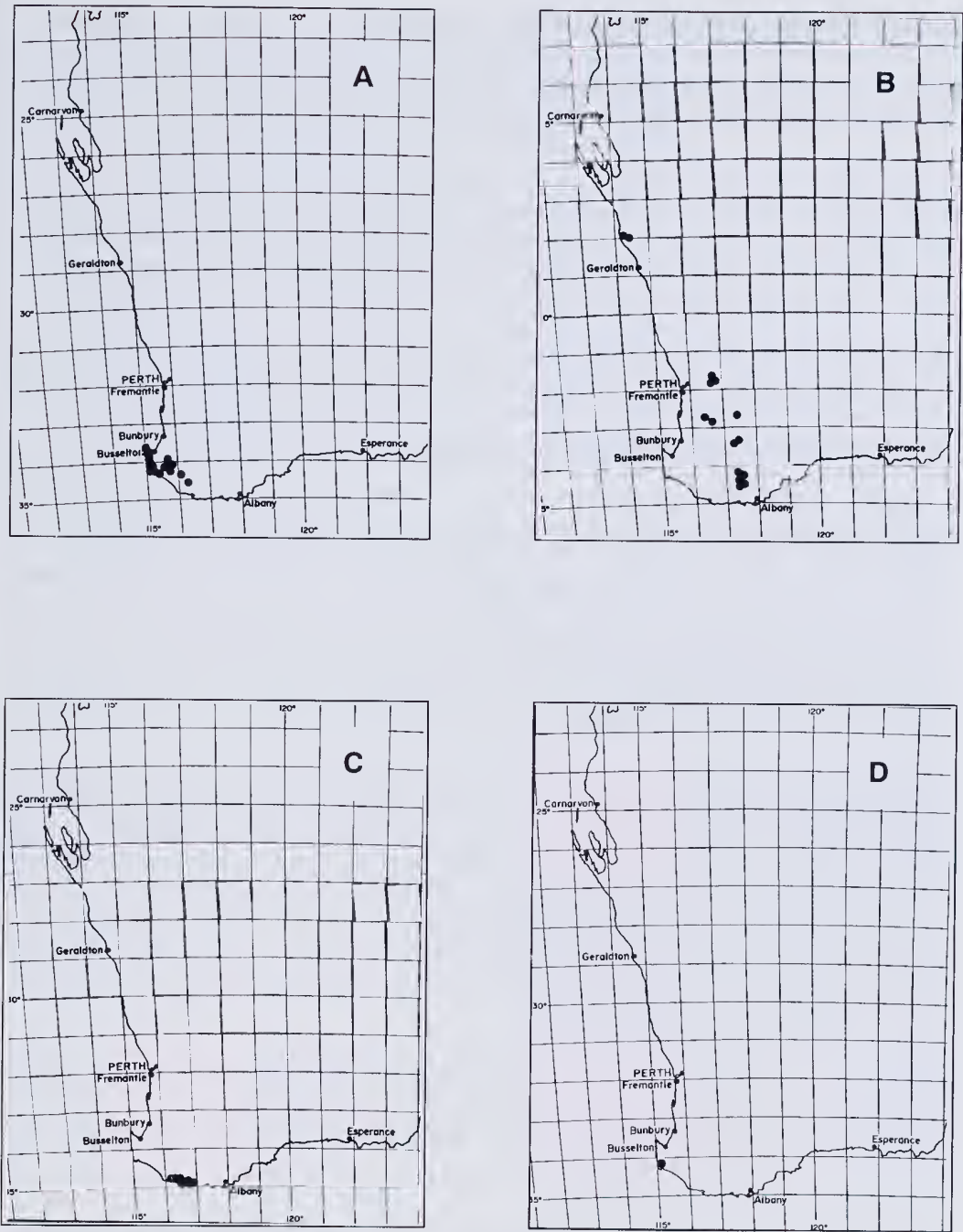


Figure 16. Distribution maps. A – *Caladenia infundibularis*; B – *C. integra*; C – *C. interjacens*; D – *C. lodgeana*.

PERTH 01708104; *iso*: AD!, CBG!, K!, MEL!, NSW!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 97 (1992) and rev. 2nd edn with suppl., p. 97 (1998).

Plant solitary or in loose colonies. *Leaf* erect, linear, 8–20 cm x 5–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1 or 2, c. 5–10 cm across, white with pale pink suffusions and markings; floral odour unknown. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore slender to prominently tumescent, 20–70 mm long in sepals, absent from petals, greyish-pink to light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 6.5–10 cm x 3–4 mm. *Lateral sepals* acutely downcurved to vertical, 7–12 cm x 5–9 mm. *Petals* spreading horizontally then downcurved, 4–5.5 cm x 3.5–5 mm. *Labellum* obscurely 3-lobed, concolorous (rarely suffused with pink) with pale pink radiating stripes, distal half of lamina with a recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate to cordate in outline when flattened, 20–25 x 10–15 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly to obliquely ascending calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with slender clubbed narrowly fusiform pale pink to white calli to 7 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4–4/5 the length of the labellum, cream or pale pink, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 18–20 x 8–12 mm, broadly winged, creamy yellow with pink blotches. *Anther* c. 3–4 x 3–4 mm, dark pink. *Pollinia* c. 3–4 mm long, yellow. *Stigma* c. 3–4 mm wide, pinkish. *Capsule* not seen. (Figure 15O–S)

Selected specimens examined. WESTERN AUSTRALIA: Crystal Springs, 21 Sep. 1976, A. Brown s.n. (PERTH 00265543); just NW of Kulikup, 33°50'S, 116°40'E, 3 Nov. 1977, A.S. George 15046 (PERTH 01035355); Walpole Nornalup National Park, 13 km WSW of Walpole, 7 km NW of Mt Hopkins, 35°01'S, 116°36'E, 9 Oct. 1983, S.D. Hopper 3541 (AD, BRI, BM, CBG, CANB, DNA, HO, K, MEL, NT, PERTH 00265616); Mandalay Beach road, c. 11.4 km SW from the Rangers' house, in Walpole National Park, 34°59'S, 116°33'E, 16 Oct. 1986, S.D. Hopper 5732 (CBG, PERTH 01698478); Banksia Track behind Clifty Head, c. 25 km WSW of Walpole, 35°01'S, 116°29'E, 28 Oct. 1987, S.D. Hopper 6295 (PERTH 01698451); Fish Creek Rd, c. 9 km SE of Lake Marginup, 34°53'S, 116°14'E, 29 Oct. 1987, S.D. Hopper 6301 (PERTH 01208896).

Distribution and habitat. Occurs on the south coast from Walpole to West Cliff Point over a narrow range of 30 km. Grows in low heath near the coast in deep sand on consolidated dunes, and occasionally in Peppermint and Yate low woodland. Flowers in greater profusion after summer fire. (Figure 16C)

Flowering period. September to October.

Etymology. Named from the Latin *interjacens* – intervening, coming between, alluding to the appearance of the flower which has a mixture of characteristics of *Caladenia longicauda* and species of the *C. huegelii* complex such as *C. appianata*.

Notes. A locally common species of the south coast with a very restricted habitat and geographical range (Priority Four). *Caladenia interjacens* has no known close relatives, differing from other members of the *C. huegelii* complex noticeably in its large white to pale pink sepals with long pale clubs, and its

white labellum. *C. nivalis* has similar white petals and sepals to *C. interjacens*, but differs in its smaller flowers, more stiffly splayed tepals, the consistently dark maroon apex on the labellum, and shorter labellum fringe. *C. interjacens* superficially resembles members of the *C. longicauda* complex, differing in the thickened osmophores on the sepals, the petals much shorter than the lateral sepals, and the pale pink floral suffusions (rarely seen in the white spider orchids).

Caladenia lodgeana* Hopper & A.P. Br., *sp. nov.

A *Caladenia serotina* Hopper & A.P. Br. petalis sepalisque clavatis et constanta floribus albis vel luteolis differt.

Typus: 0.7 km south along Boodijup Rd, c. 1.5 km south-west of Margaret River, 33°57'S, 115°04'E, Western Australia, 7 December 1987, S.D. Hopper 6320 (*holo*: PERTH 01200976).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 420 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–20 cm x 5–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1 or 2, c. 5–10 cm across, creamy-yellow with occasional suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a long-acuminate apex with an osmophore; osmophore narrowly tumescent, 15–35 mm long on sepals, 3–10 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* 5–7 cm x 2–3 mm, erect and slightly incurved. *Lateral sepals* spreading and downcurved, 5.5–7.5 cm x 4–6 mm. *Petals* horizontal to somewhat downcurved, 3.5–6.5 cm x 2–4 mm. *Labellum* obscurely 3-lobed, uniformly coloured except basal lamina occasionally suffused pink, with pink to red radiating stripes, stiffly articulate on a claw c. 1.5–2 mm wide; lamina narrowly cordate in outline when flattened, 18–25 x 11–15 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins within 4 mm of the claw, becoming fimbriate with slender clubbed narrowly fusiform cream to dark maroon white-tipped calli to 8 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3 the length of the labellum, pink, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 18–20 x 6–10 mm, broadly winged, creamy yellow with prominent pink blotches. *Anther* c. 3 x 3 mm, pale yellowish pink. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3 mm wide, yellow-green. *Capsule* not seen. (Figure 17A–M)

Selected specimen examined. WESTERN AUSTRALIA: 2.5 km SW of Augusta, 1 km S of Golf Course Rd, 34°20'S, 115°08'E, 26 Oct. 1984, E. Chapman (PERTH 00404349).

Distribution and habitat. Known only from near Augusta where it grows in clay soils in or on the margins of winter-wet areas and below granite outcrops, under low scrub of *Dodonaea ceratocarpa*, *Melaleuca* and *Leptospermum* to 1 m high and emergent taller Marri. (Figure 16D)

Flowering period. Late October to early December.

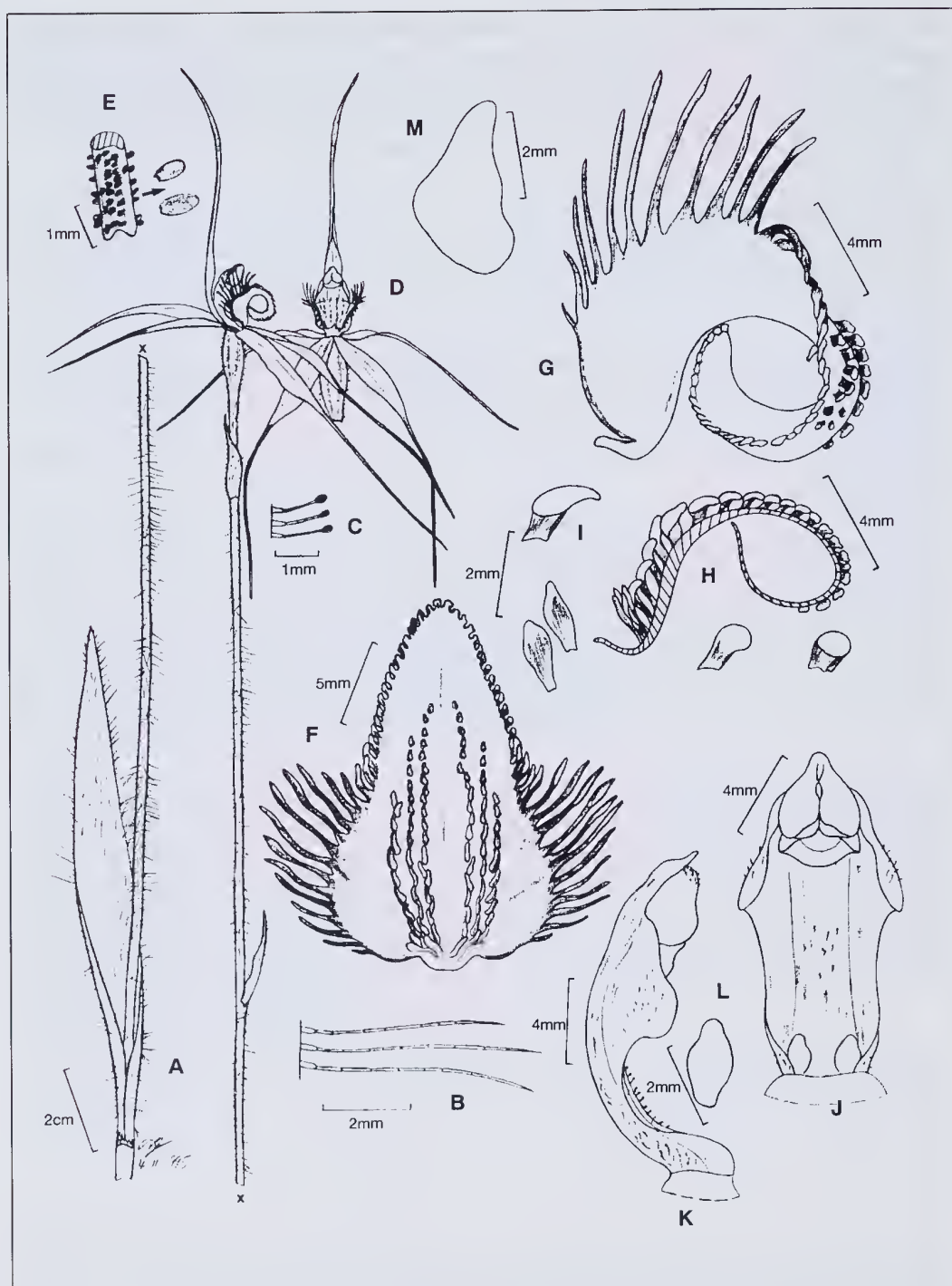


Figure 17. *Caladenia lodgeana* from Augusta, C.J. French s.n. A – plant; B – hairs from lower scape; C – hairs on upper scape; D – flower from front; E – hairs from tepal apex; F – flattened labellum from above; G – labellum from side; H – longitudinally sectioned labellum from side; I – calli; J – column from front; K – column from side; L – one of two yellow glands at base of column; M – pollinia. Drawn by D.L. Jones.

Etymology. Named after Harry Lodge (1915–), foundation member of the Western Australian Native Orchid Study and Conservation Group, distinguished judge for Australian exotic orchid groups, and who provided encouragement to us both during formative years in orchid research.

Notes. An uncommon, extremely localised species first recognised as distinct by Greg Bussell (after whom *Caladenia busselliana* is named) who brought it to our attention in 1991. *Caladenia lodgeana* has the sepals with a thickened osmophore and shortened petals of the *C. huegelii* complex, but differs from all other Western Australian species (apart from *C. busselliana* and *C. interjacens*) in its labellum lacking a dark maroon apex. *C. lodgeana* differs from *C. busselliana* and *C. interjacens* in its petals with an osmophore, its intermediate floral size, its later flowering period and its confinement to the Augusta area.

Caladenia longicauda Lindl. in *Edward's Bot. Reg.* 1–23: Swan River Append. lii (1840). – *Caladenia patersonii* R.Br. var. *longicauda* (Lindl.) R.S. Rogers, *Trans. & Proc. Roy. Soc. S. Austral.* 44: 351 (1920). **Type:** Swan River, 1839, *J. Drummond s.n.* (lecto: K-L!, *fide* Clements (1989: 27); *isolecto*: BM!, G n.v., K!).

Plant solitary or in small to large dense clumps. **Leaf** erect, linear, 10–25 cm x 5–20 mm, pale green, basal third usually irregularly blotched with red-purple. **Scape** 25–60 cm tall. **Flowers** 1–3(5), c. 5–18 cm across, white to creamy-yellow except for maroon markings on calli and pale maroon to pink lines on the back of petals and sepals; floral odour faintly to strongly sweet, musky or acrid. **Sepals and petals** stiffly held to lax, linear-lanceolate in basal 1/5–1/2, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. **Dorsal sepal** erect to curving forward near apex, 3–14 cm x 2–6 mm. **Lateral sepals** spreading, obliquely downcurved or vertically hanging, 3–15 cm x 3–10 mm. **Petals** horizontal basally, then somewhat to prominently downcurved or vertically hanging, 3–12 cm x 2.5–6 mm. **Labellum** obscurely 3-lobed, uniformly coloured except basal lamina sometimes with pale maroon radiating stripes, stiffly articulate on a claw c. 2–3 mm wide; lamina narrowly to broadly cordate in outline when flattened, 7–28 x 6–18 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins within 7 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform pale to rich maroon white-tipped calli to 10 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. **Lamina calli** in 4 rows (sometimes towards apex up to 8, or less than 4 rows, or irregularly aggregated) extending at least 2/3 the length of the labellum, pale to dark maroon, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. **Column** 12–22 x 5–11 mm, winged, greenish yellow with maroon blotches and suffusions. **Anther** c. 2–7 x 2–7 mm, maroon with yellowish suffusions. **Pollinia** c. 2–4 mm long, yellow. **Stigma** c. 2–5 mm wide, yellow-green. **Capsule** not seen.

Distribution and habitat. Found throughout the south-west of Western Australia between Nerren Nerren Station, north-east of Kalbarri and Israelite Bay growing in a variety of habitats including winter-wet swamps, coastal heath, forests, inland mallee woodlands, granite outcrops and salt lake margins. Soils vary from deep sand to lateritic loam.

Flowering period. July to November.

Notes. This species has had a tortuous taxonomic history. Lindley, in the protologue, described it as “singular”, alluding to its beauty and distinctness compared with spider orchids of the “south and east coast”. Lindley (1840b) had seen specimens of Robert Brown’s *Caladenia patersonii*, and considered

C. longicauda to be specifically distinct. Reichenbach (1871) agreed with Lindley that *C. longicauda* was a distinct species, differing from *C. patersonii* in its oblong labellum with calli becoming small and densely aggregated towards the apex. In contrast, Benth (1873) did not recognise *C. longicauda* at all, and reduced it to a synonym of his *C. patersonii* var. *dilatata* (R. Br.) Benth. This view was supported by Mueller (1882, 1889).

Almost forty years after Benth's publication, Domin (1912) reinstated *Caladenia longicauda* as a species, and named a new variety (*eminens*). Subsequently, Rogers (1920) reduced *C. longicauda* to a variety within *C. patersonii*, a view followed by Pelloe (1930), Gardner (1930), Erickson (1965), Nicholls (1969) and George (1971).

Clements (1985) listed *Caladenia longicauda* at specific rank, and stated that "recent revisionary studies by Hopper (pers. comm.) suggest that species rank is appropriate."

Clements (1989: 27) considered *Caladenia longicauda* to be "apparently restricted to the sandy coastal plain around Perth" but provided no discussion or evidence. Jones (1988: 125), who based his taxonomy on Clements (1989), stated for *C. longicauda* "Endemic to WA (Darling Scarp)... This species has been confused until very recently with the Common White Spider Orchid of WA, the correct name of which is *C. eminens*... *C. longicauda* (sic) grows in swampy areas fairly close to Perth and appears to be poorly known."

We have examined the types of both *Caladenia longicauda* and *C. eminens*. We consider that the taxon known to occur in swampy areas near the Darling Scarp is the distinct species described herein as *C. splendens*, which is more robust than that represented by the type of *C. longicauda*. The labellum of *C. splendens* when fresh is 15–22 mm wide and its lateral sepals are 10.5–19 cm long and 8–11 mm wide. The dried lectotype of *C. longicauda* has a labellum 9 mm wide and lateral sepals 10 cm long and 4 mm wide. Allowing for shrinkage, the lectotype falls near the small end of fresh material of our concept of typical *C. longicauda* (i.e. labellum lamina 10–15 mm wide; lateral sepals 9–13 cm x 5–8 mm).

Lindley clearly illustrated on the type sheet and in the protologue of *Caladenia longicauda* the presence of more than four rows of calli towards the labellum apex. However, this is not diagnostic, being found in both *C. longicauda* and *C. splendens*.

Typical *Caladenia longicauda* is widespread in well-drained soils in the Jarrah forest and the inland side of the Swan Coastal Plain between Lancelin and Mount Barker. Furthermore, despite the distinctness of the types of *C. longicauda* and *C. eminens*, which we understand was instrumental in convincing M. Clements (pers. comm. 1987) that these taxa were distinct species, our studies of population variation throughout the range of the *C. longicauda* complex show that intergradation of *longicauda* and *eminens* occurs at many sites where their ranges overlap. Even with fresh material on hand, there are many populations in this zone of overlap that defy clear placement as either *longicauda* or *eminens*. Elsewhere, the two taxa are consistently distinct. With this in mind, subspecific status seems more appropriate, and is consistent with how we have treated other taxa in the complex that show similar patterns of intergradation. Our concern is that, should *longicauda* and *eminens* be recognised as species, all 11 subspecies of *C. longicauda* we recognize should be so treated for consistency. This would pose significant identification problems in the numerous areas where taxa intergrade.

Thus, we consider that *Caladenia longicauda* is a complex of overlapping geographical races, eleven of which are sufficiently distinct to be recognized as subspecies.

Apart from *Caladenia splendens*, there are a number of other south-western spider orchid species lacking a red labellum apex and allied to *C. longicauda* that we recognise. These include *C. speciosa*, *C. serotina*, *C. cruscula*, *C. christineae*, *C. citrinu*, *C. pholcoidea* and *C. uliginosa* (subsp. *candicans*).

From *Caladenia speciosa*, *C. longicauda* differs in its narrowly fusiform (not bifurcating) labellum marginal calli and its maroon (not pinkish) floral markings. *C. longicauda* differs from *C. serotina* in its less prominent maroon floral markings and its earlier flowering season. *C. cruscula* has very small flowers with abbreviated petals and sepals. Only *C. longicauda* subsp. *rigidula* grows close to *C. cruscula* and approaches it in size. However, the vast majority of populations of *C. longicauda* differ from *C. cruscula* in their larger flowers with longer petals and sepals and a longer labellum.

Caladenia longicauda differs from *C. christineae* in its longer labellum marginal calli and usually larger flowers. From *C. citrina*, it differs in its white to creamy yellow (not pale lemon yellow) floral colour and its labellum with longer marginal calli. *C. longicauda* also has longer marginal labellum calli than *C. pholcoidea*, as well as an earlier flowering season. *C. uliginosa* has much shorter marginal calli on its labellum than *C. longicauda*.

Key to subspecies of *Caladenia longicauda*

1. Column longer than 18 mm
 2. Lateral sepals 9.5–15 cm x 3–6 mm, linear-lanceolate in basal 1/7–1/5.
Labellum lamina 20–28 x 9–11 mm, narrowly cordate in outline when flattened. subsp. **merrittii**
 - 2: Lateral sepals 7–13 cm x 5–10 mm, linear-lanceolate in basal 1/5–1/3.
Labellum lamina 17–25 x 10–18 mm, narrowly to broadly cordate in outline when flattened
 3. Lateral sepals 9–13 cm long, linear-lanceolate in basal 1/5–1/4.
Labellum lamina 10–15 mm wide, narrowly cordate in outline when flattened. Occurs south-west of a line between Lancelin and Mount Barker subsp. **longicauda**
 - 3: Lateral sepals 7–10 cm long, linear-lanceolate in basal 1/4–1/3.
Labellum lamina 12–18 mm wide, cordate to broadly cordate in outline when flattened. Occurs in the vicinity of Esperance eastwards to Cape Arid National Park subsp. **crassa**
- 1: Column shorter than 18 mm
 4. Labellum when flattened 10 mm or less wide
 5. Lateral sepals less than 6 cm long, sepals and petals with stiffly held filamentous apices. Ravensthorpe to north-east of Esperance subsp. **rigidula**
 - 5: Lateral sepals more than 6 cm long, sepals and petals with lax vertical filamentous apices. West of Borden
 6. Lamina calli usually irregularly aggregated towards apex.
Calcareous sand, near-coastal subsp. **calcigena**
 - 6: Lamina calli usually in rows towards apex. Acidic soils, usually

inland from coast

7. Labellum lamina 12–15 x 6–8 mm when flattened. Waterlogged winter-wet soils subsp. **albella**
- 7: Labellum lamina 15–25 x 7–10 mm when flattened. Well drained soils
8. Labellum marginal calli to 10 mm long; lamina calli usually in up to 8 rows towards apex subsp. **borealis**
- 8: Labellum marginal calli to 5 mm long; lamina calli usually in 2 or 4 rows towards apex
9. Lateral sepals less than 9 cm long. Darling Plateau between Collie and Darkan south-east to Mount Barker subsp. **redacta**
- 9: Lateral sepals more than 9 cm long. Darling Scarp and near Dunsborough subsp. **clivicola**
- 4: Labellum when flattened more than 10 mm wide
10. Lateral sepals more than 9 cm long, 6–12 mm wide. Inland areas, acidic soils... subsp. **eminens**
- 10: Lateral sepals less than 9 cm long, 5–7 mm wide. Coastal areas, calcareous soils... subsp. **australora**

Caladenia longicauda* Lindl. subsp. *longicauda

Illustrations. E. Pelloe, *West Australian Orchids*, frontispiece colour plate no. 4 [as *C. patersonii* var. *longicauda*] (1930); R. Erickson, *Orchids of the West*, 2nd edn, frontispiece No. 5 [as *C. patersonii* var. *longicauda*] (1965); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st edn, p. 50 plate 122 (1973); D. Jones, *Native Orchids of Australia*, p. 124 (1988); E. Bennett, *The Bushland Plants of Kings Park Western Australia*, Figure 227 (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 74, [as *Caladenia patersonii* var. *patersonii*] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 80 (1992) and rev. 2nd edn with suppl., p. 80 (1998).

Plant usually solitary, occasionally in small clumps. *Leaf* 5–15 mm wide. *Scape* 35–60 cm tall. *Flowers* c. 6–9 cm across. *Sepals and petals* stiffly held basally, with a lax filamentous apex, linear-lanceolate in basal 1/5–1/4. *Dorsal sepal* 7–11 cm x 3 mm. *Lateral sepals* spreading basally, then vertically hanging, 9–13 cm x 5–8 mm. *Petals* horizontal basally, then vertically hanging, 7.5–9 cm x 3–4 mm. *Labellum lamina* narrowly cordate in outline when flattened, 17–24 x 10–15 mm; lateral lobes with marginal calli to 8 mm long. *Lamina calli* sometimes in up to 8 rows towards apex, to c. 2 mm tall. *Column* 18–22 x 8–10 mm. (Figures 15T–X)

Selected specimens examined. WESTERN AUSTRALIA: Kalamunda, 2 Sep. 1939, A.B. Cashmore 85 (PERTH 00271802); Kewdale, 31°58'S, 115°58'E, 7 Oct. 1976, R. Coveny 8214 (PERTH 00277606); S of Yallingup, 8 Oct. 1967, A.S. George 9204a (PERTH 01935119); 6 km NW of Nannup on Mowen Rd, 9.4 km W of Blackwood River Bridge, 33°57'S, 115°42'E, 10 Oct. 1983, S.D. Hopper 3559 (PERTH 00271357); Jilakin Rock, 14 km W of Kulin, 20 km SSE of Kondinin, 32°40'S, 118°20'E, 7 Sep. 1984, S.D. Hopper 4116 (CBG, PERTH 00279072); N side of Beermullah West Rd, on a farm, 11.4 km E of Cowallis Rd, c. 24 km NW of Gingin, 31°14'S, 115°42'E, 18 Sep. 1987, S.D. Hopper 6079 (CBG, PERTH 01190830); Yarra Rd, 5.6 km N of Brookton Highway, c. 40 km E of Armadale, 32°12'S, 116°26'E, 23 Sep. 1988, S.D. Hopper 6758 (CBG, PERTH 01198823); Helena Valley, 7 Sep. 1977, J. Seabrook 203 (PERTH 00278971); Hay River, c. 8 km SW of Mount Barker, 4 Oct. 1975, R. Tinetti s.n. (PERTH 00874698).

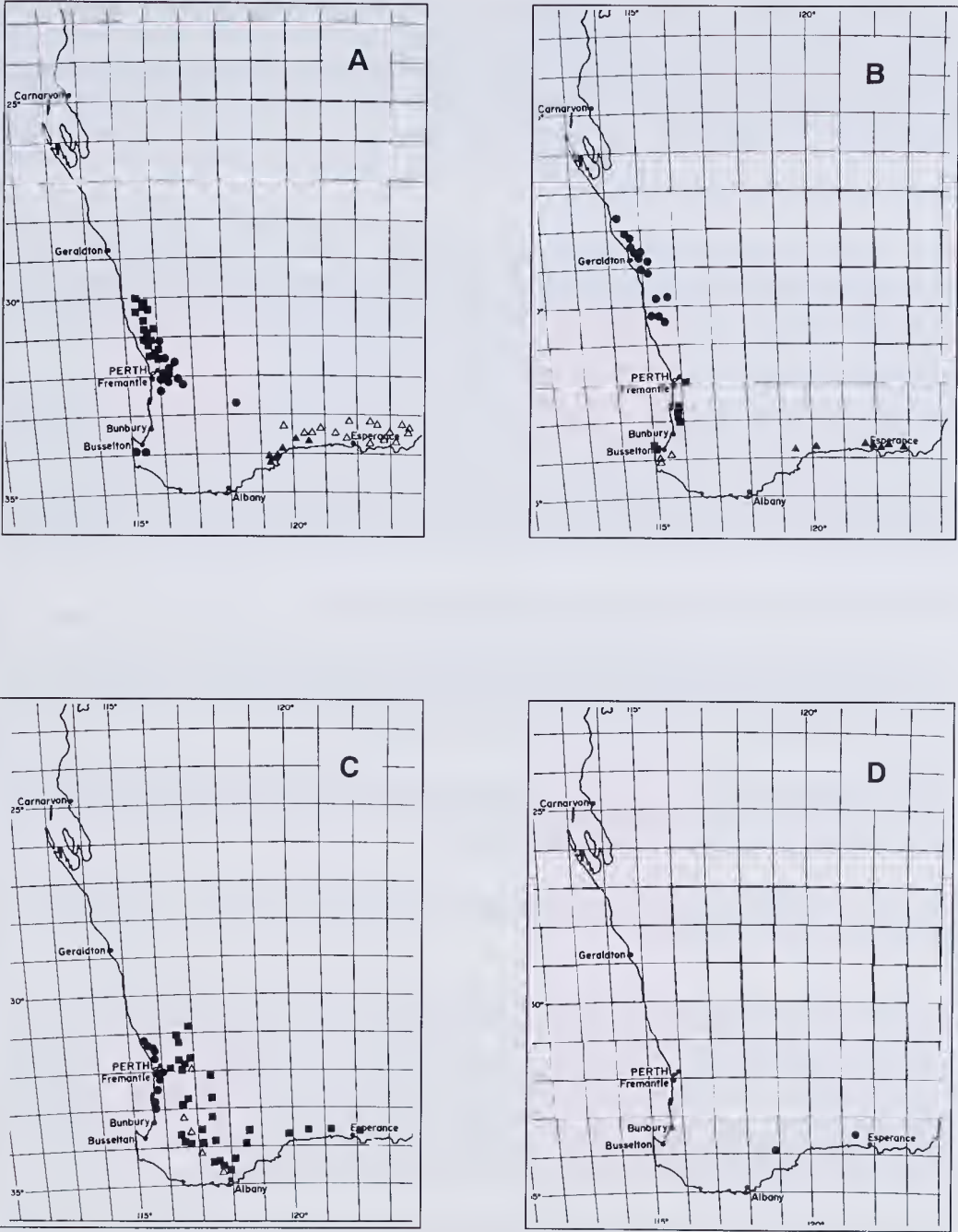


Figure 18. Distribution maps. A – *C. longicauda* subsp. *longicauda* ●, *C. longicauda* subsp. *albella* ■, *C. longicauda* subsp. *australora* ▲ and *C. longicauda* subsp. *rigidula* △; B – *C. longicauda* subsp. *borealis* ●, *C. longicauda* subsp. *clivicola* ■, *C. longicauda* subsp. *crassa* ▲ and *C. longicauda* subsp. *merrittii* △; C – *C. longicauda* subsp. *calcigena* ●, *C. longicauda* subsp. *eminens* ■ and *C. longicauda* subsp. *redacta* △; D – *Caladenia longifimbriata*.

Distribution and habitat. Ranges down the Swan Coastal Plain inland from Lancelin to the southern suburbs of Perth, and is common throughout the Jarrah forest between Perth, Mount Barker and Nannup. Occurs on well-drained sands in low woodlands of *Banksia* and Jarrah on the Swan Coastal Plain. In the Jarrah forest *Caladenia longicauda* subsp. *longicauda* favours well-drained gravelly loams and sands. (Figure 18A)

Flowering period. September to October.

Notes. *Caladenia longicauda* subsp. *longicauda* is distinguished from other subspecies by a combination of its relatively large flowers, and its long narrow labellum with long marginal calli. The basal lamina of the lateral sepals of subsp. *longicauda* is narrow compared with that of subsp. *eminens*. Subsp. *longicauda* is usually solitary in habit, whereas subsp. *eminens* often forms large clumps. These two subspecies intergrade where Wandoo woodland abuts Jarrah forest.

Caladenia longicauda subsp. *longicauda* also appears to intergrade with *C. longicauda* subsp. *borealis* near Cataby (e.g. *S.D. Hopper* 6004), and with *C. longicauda* subsp. *calcigena* where the Bassendean Dunes meet the Spearwood Dunes on the Swan Coastal Plain (e.g. at Joondalup). *C. longicauda* subsp. *longicauda* differs from both these latter subspecies in its larger labellum and longer column.

***Caladenia longicauda* subsp. *albella* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. petalis angustis pendulis et sepalis lateralibus 5–11 cm longis et 3–5 mm latis, labello angusto 12–15 mm longo et 6–8 mm lato fimbria marginali 4–6 mm longa, columna 12–15 mm alta, florum odoribus acris differt.

Typus: Beermullah West Rd, 5.3 km east of Cowalla Rd, c. 30 km north-west of Gingin, 31°14'S, 115°38'E, Western Australia, 18 September 1987, *S.D. Hopper* 6073 (*holo:* PERTH 01751530; *iso:* AD!, CBG!, K!, MEL!, NSW!, PERTH 01751549).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 74 (1992) and rev. 2nd edn with suppl., p. 74 (1998).

Plant usually solitary, occasionally in small clumps. **Leaf** 3–11 mm wide. **Scape** 25–45 cm tall. **Flowers** c. 5–10 cm across. **Sepals and petals** stiffly held basally, with a lax filamentous apex, linear-lanceolate in basal 1/5–1/4. **Dorsal sepal** 6–9 cm x 2–2.5 mm. **Lateral sepals** spreading basally, then vertically hanging, 6–11 cm x 3–5 mm. **Petals** horizontal basally, then downcurved to vertically hanging 4.5–8.5 cm x 2–3 mm. **Labellum lamina** narrowly cordate in outline when flattened, 12–15 x 6–8 mm; lateral lobes with marginal calli to 4–6 mm long. **Lamina calli** usually in 2–4 rows towards apex, rarely up to 8 rows, to c. 1.5 mm tall. **Column** 12–15 x 4–6 mm. (Figure 19A–F)

Selected specimens examined. WESTERN AUSTRALIA: Boothendarra Hill, c. 60 km NW of Moora, 30°16'S, 115°33'E, 10 Sep. 1987, *S.D. Hopper* 6018a (AD, CBG, PERTH 01668595); 9 km NW of Dobaderry Swamp; c. 35 km W of Beverley, 32°10'S, 116°31'E, 11 Sep. 1987, *S.D. Hopper* 6027 (PERTH 01676504); Beermullah West Rd, 5.3 km E of Cowallis Rd, c. 30 km NW of Gingin, 31°14'S, 115°38'E, 18 Sep. 1987, *S.D. Hopper* 6074 (PERTH 01711636); Gingin Access Rd, 0.2 km E across the railway line, at the foot of the scarp, c. 5 km S of Gingin, 31°23'S, 115°55'E, 20 Sep. 1988, *S.D. Hopper* 6725 (AD, MEL, PERTH 01667475); Yeal Swamp Rd, Yanchep National Park, 50 km N of

Perth, 30 Sep. 1989, G.J. Keighery 11565 (PERTH 01668072).

Distribution and habitat. Occurs mainly on the coastal plain between Eneabba and Gingin, with isolated inland populations scattered between Beverley, Wongan Hills and south of Mingenew. Grows in waterlogged winter-wet soils in swamps, along creeklines and on lake margins in Flooded Gum or *Melaleuca* low woodlands, low heath or sedgeland. (Figure 18A)

Flowering period. Late August to October.

Etymology. Named from the Latin *albus* (dull white) and the diminutive suffix *ellus* (small), alluding to the smaller size of the subspecies compared with most other subspecies of *Caladenia longicauda*.

Notes. *Caladenia longicauda* subsp. *albella* is a common but habitat-specific orchid overlapping in distribution with subsp. *borealis*. The latter has darker colouration, a larger labellum with a somewhat longer fringe, and grows in drier soils in woodlands.

Subsp. *albella* differs from other subspecies of *Caladenia longicauda* in its narrow petals and lateral sepals, its small narrow labellum, its small column, its acrid floral odour, and/or its preference for soils that are waterlogged in winter

***Caladenia longicauda* subsp. *australora* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. petalis sepalisque rigide effusis, sepalis lateralibus 7–8.5 cm longis, et labello ovato segmentis fimbriae relative gracilibus ad 4–7 mm longis differt.

Typus: Beaufort Inlet, at end of Millers Point Rd, 34°27'S, 118°53'E, Western Australia, 28 September 1987, S.D. Hopper 6132 (*holo:* PERTH 01707051; *iso:* AD!, CBG!, K!).

Illustrations. M. Pocock, Ground Orchids of Australia, photo 32, [as *Caladenia patersonii* var. *longicauda*] (1972); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 79 (1992) and rev. 2nd edn with suppl., p. 79 (1998).

Plant usually solitary, occasionally in small clumps. *Leaf* 5–10 mm wide. *Scape* 15–35 cm tall. *Flowers* c. 5–8 cm across. *Sepals and petals* stiffly held basally, with a lax filamentous apex, linear-lanceolate in basal 1/5. *Dorsal sepal* 6.0–8.0 cm x 2–3 mm. *Lateral sepals* spreading basally, then vertically hanging, 7.0–8.5 cm x 5–7 mm. *Petals* horizontal basally, then downcurved to vertically hanging, 4.5–7.5 cm x 3–4 mm. *Labellum lamina* narrowly cordate to cordate in outline when flattened, 18–25 x 10–13 mm; lateral lobes with marginal calli to 4–7 mm long. *Lamina calli* in 4 rows towards apex, to c. 1.5 mm tall. *Column* 14–18 x 7–10 mm.

Selected specimens examined. WESTERN AUSTRALIA: track from Fitzgerald River Inlet to Middle Mt Barren, Sep. 1970, T.E.H. Aplin 3760 (PERTH 00278017); Hamersley Inlet, Fitzgerald River National Park, 34°05'S, 119°35'E, 4 Sep. 1990, S.D. Hopper 7847 (PERTH 1829947); 23 km N of Bremer Bay and 5 km NW of West Mt Barren, 34°11'S, 119°24'E, 3 Oct. 90, S.D. Hopper 7875 (PERTH 1828886); 15 km SW of Oldfield River Bridge (E of Ravensthorpe), 29 Aug. 1975, S.D. Hopper 85

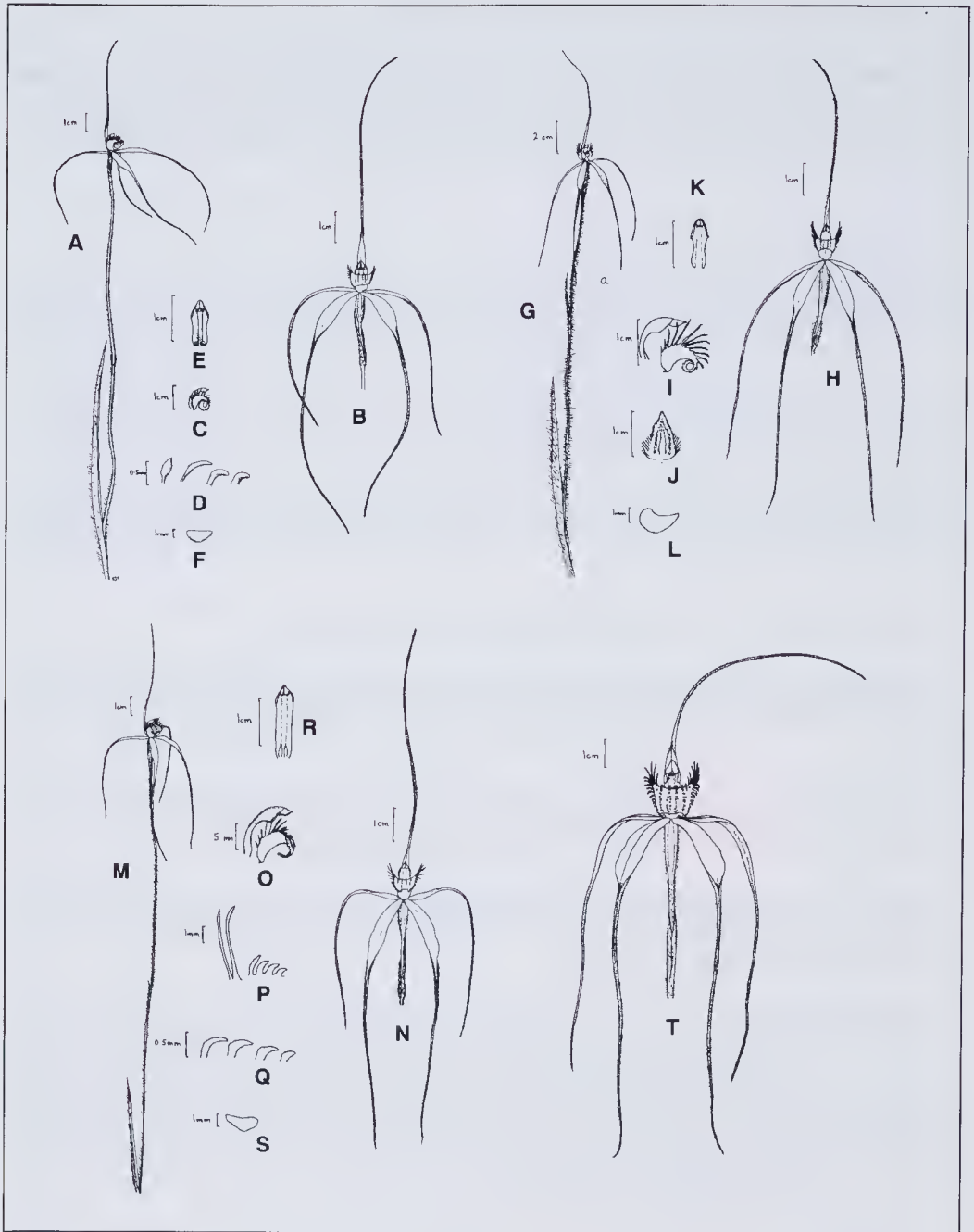


Figure 19 A–F. *Caladenia longicauda* subsp. *albella* from the Gingin area, A.P. Brown s.n. A – plant; B – flower from front; C – labellum and column from side; D – calli; E – column from front; F – pollinia. G–L. *C. longicauda* subsp. *calcigena* from the Perth area, A.P. Brown s.n. G – plant; H – flower from front; I – labellum and column from side; J – labellum from above; K – column from front; L – pollinia. M–S. *C. longicauda* subsp. *clivicola* from the Harvey area, S.D. Hopper 6104. M – plant; N – flower from front; O – labellum and column from side; P – labellum fringe; Q – calli; R – column from front; S – pollinia. T – *C. longicauda* subsp. *crassa* from the Esperance area, A.P. Brown s.n., flower from front. Drawn by S.J. Patrick.

(PERTH 00278556); base of West Mt Barren, Fitzgerald River National Park, 20 Sep. 1969, K.R. Newbey 2897 (PERTH 00278580); 8 km from Ravensthorpe towards Hopetoun, 33°37'S, 120°07'E, 11 Sep. 1983, J. Taylor & P. Ollerenshaw 1703 (PERTH 00796433).

Distribution and habitat. Known from near-coastal sites in the Fitzgerald River National Park and westwards at least to Miller's Point. Grows in coastal low woodlands of *Eucalyptus platypus* var. *heterophylla*, *E. praetermissa* and *Melaleuca lanceolata*, occasionally penetrating inland 10–15 km around fringing mallee and within Swamp Yate flats. Calcareous sands and sandy-loams are the preferred soil. (Figure 18A)

Flowering period. September to October.

Etymology. Named from the Latin *australis* (southern) and *ora* (coast), alluding to the geographical distribution of the subspecies.

Notes. A poorly known subspecies that intergrades with *Caladenia longicauda* subsp. *eminens* inland from the coast, but remains in pure populations near the sea. Apart from its calcareous habitat, subsp. *australora* is distinguished from subsp. *eminens* by its uniformly smaller flowers and relatively narrow labellum and lateral sepals. Subsp. *eminens* has not been recorded on calcareous soils.

***Caladenia longicauda* subsp. *borealis* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. floribus labello relative parvo, segmentis fimbriae labelli relative longis gracilibus ad 6–10 mm longis, callis parvis ad 1.5 mm longis diminuentibus sed serialibus ad apicem labelli differt.

Typus: 16 km west-north-west of Northampton, 1 km north-east of Horrocks Rd on Port Gregory Rd, 28°12'S, 114°30'E, Western Australia, 24 August 1983, S.D. Hopper 3352 (*holo:* PERTH 00279048; *iso:* AD!, CBG!, K!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 75 (1992) and rev. 2nd edn with suppl., p. 75 (1998).

Plant usually in small clumps, occasionally solitary. *Leaf* 6–12 mm wide. *Scape* 25–40 cm tall. *Flowers* c. 8–12 cm across. *Sepals and petals* stiffly held and obliquely downcurved basally, then with a lax vertical filamentous apex, linear-lanceolate in basal 1/5. *Dorsal sepal* 6–10 cm x 2–3 mm. *Lateral sepals* spreading basally, then obliquely downcurved, 7–10 cm x 4–7 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 6–9.5 cm x 3–4 mm. *Labellum lamina* narrowly cordate in outline when flattened, 15–20 x 7–10 mm; lateral lobes with marginal calli to 10 mm long. *Lamina calli* usually in up to 8 rows towards apex, to c. 1.5 mm tall. *Column* 15–18 x 6–10 mm.

Selected specimens examined. WESTERN AUSTRALIA: c. 5 miles [8 km] W of Nanson, c. 24 miles [39 km] NNE of Geraldton by road, 27 Aug. 1970, R. Coveny 3066 (PERTH 00272248); Coomallo Picnic Ground, 9 Oct. 1978, R.J. Cranfield 835 (PERTH 00277533); 16 km SW of Dandaragan, 5 km SE of Cataby, 30°46'S, 115°35'E, 11 Aug. 1983, S.D. Hopper 3120 (CBG, PERTH 00277150); Kalbarri Rd, c. 9 km WSW of Murchison House Station turnoff, 27°41'S, 114°15'E, 8 Aug. 1986, S.D. Hopper 5177 (PERTH 01192426); 3.1 km W of the Brand Highway, near a tributary to the S of the main drainage line; c. 19 km S of Eneabba, 29°54'S, 115°16'E, 20 Sep. 1988, S.D. Hopper 6726 (PERTH 01697927); c. 15 km WNW of Northampton on the Port Gregory road, just W of Swamp Rd, 28°18'S, 114°29'E, 8

Aug. 90, S.D. Hopper 7820 (PERTH 1829750); Jurien Bay, 9 Aug. 1967, S.K. Kah s.n. (PERTH 00912204).

Distribution and habitat. Extends from Cataby north to Kalbarri National Park, often growing in clay loams above creek lines in Wandoo woodland or heath, but sometimes in sandy soils beneath sheoak low woodland. (Figure 18B)

Flowering period. July to September.

Etymology. Named from the Latin *borealis* (northern), alluding to the distribution of the subspecies.

Notes. A sporadically distributed subspecies identified by its short column, stiffly held tepal bases, small labellum with a relatively long fringe, and its calli in even rows towards the labellum apex. It is similar to *C. longicauda* subsp. *calcigena*, which differs in its longer sepals and petals, and its small apical calli tending to aggregate in an irregular agglomeration rather than terminating in neat rows, and its confinement to calcareous sands.

Caladenia longicauda subsp. *borealis* overlaps in distribution with subsp. *albella*. The latter has paler colouration, a smaller labellum with shorter marginal calli on the labellum, and grows in waterlogged winter-wet soils in swamps, along creeklines and on lake margins.

***Caladenia longicauda* subsp. *calcigena* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. floribus labello relative parvo angusto, segmentis fimbriae labelli gracilibus ad 4–8 mm longis et callis parvis ad 2 mm longis diminuentibus et aggregatis in maculatis coloribus parvissimis prope apicem labelli differt.

Typus: Madora, 9 km north of Mandurah towards Perth, Western Australia, 17 September 1983, G.J. Keighery 6420 (*holo:* PERTH 00261815).

Illustrations. D. Clyne, Australian Ground Orchids, pp. 38, 107, [as *Caladenia patersonii* var. *longicauda*] (1970); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 76 (1992) and rev. 2nd edn with suppl., p. 76 (1998).

Plant usually solitary, occasionally in small clumps. *Leaf* 8–12 mm wide. *Scape* 25–40 cm tall. *Flowers* c. 3–10 cm across. *Sepals and petals* stiffly held and horizontal to obliquely downcurved basally, then with a lax vertical filamentous apex, linear-lanceolate in basal 1/7–1/5. *Dorsal sepal* 7–12 cm x 2–3 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 7–14 cm x 4–7 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 6.5–10.5 cm x 2–3.5 mm. *Labellum lamina* narrowly cordate in outline when flattened, 16–22 x 7–10 mm; lateral lobes with marginal calli to 7 mm long. *Lamina calli* usually irregularly aggregated, towards apex, to c. 1.5 mm tall. *Column* 13–18 x 6–8 mm. (Figure 19G–L)

Selected specimens examined. WESTERN AUSTRALIA: Wanneroo, Sep. 1949, M.C. George s.n. (PERTH 00277614); 300 m E of Mandurah–Fremantle road on Paganoni Rd, 12 km NNE of Mandurah, 32°26'S, 115°47'E, 12 Sep. 1984, S.D. Hopper 4135 (PERTH 00277525); Quinns Rd, W of Lancelin Rd, c. 12 km NNW of Wanneroo, 31°40'S, 115°43'E, 13 Sep. 1987, S.D. Hopper 6031 (PERTH

01192434); Johnson Rd, c. 0.3 km N of Thomas Rd, Orelia, 32°13'S, 115°50'E, 16 Sep. 1987, S.D. Hopper 6040 (PERTH 01208888); Bold Park, Floreat Park, 8 km W of Perth, 14 Sep. 1988, G.J. Keighery 11227 (PERTH 01712071); corner of Warton and Ranford Rds, 60 m NE of the lights, in remnant bushland, 32°04'S, 115°55'E, 5 Oct. 1989, A. Napier s.n. (PERTH 1828428).

Distribution and habitat. Confined to the Swan Coastal Plain on the near-coastal Spearwood Dune System between Bunbury and Cliff Head. Grows in Tuart woodland, low *Banksia* woodlands and coastal heath, mainly in yellow sand overlying limestone. (Figure 18C)

Flowering period. September to October.

Etymology. Named from the Latin *calce* (lime) and the suffix *-genus* (born or produced in a certain place), alluding to the limestone soils which the subspecies occupies.

Notes. A common subspecies once widespread in near-coastal suburbs of metropolitan Perth, but now confined there to small remnants of uncleared bushland. *Caladenia longicauda* subsp. *calcigena* is readily identified by its short column, its relatively small narrow labellum with slender fringe calli and small lamina calli decreasing in size to a crowded mass of maroon dots near the labellum apex. It grows with or near to *C. longicauda* subsp. *longicauda* where the Spearwood and Bassendean Dune systems abut (e.g. Joondalup, Medina). It also often grows with another endemic of the Spearwood Dunes, *C. georgei*, occasionally producing colourful hybrids.

Caladenia longicauda subsp. *calcigena* is similar to subsp. *clivicola*, but the latter differs in its taller scapes (to 50 cm), its shorter labellum marginal calli, its lamina calli in uniform rows towards the labellum apex, and its occurrence in acidic loamy soils near exposed granite. Subsp. *calcigena* is also similar to subsp. *borealis*, but differs in its longer sepals and petals, and its small apical calli tending to aggregate in an irregular agglomeration rather than terminating in neat rows, and its confinement to calcareous sands.

***Caladenia longicauda* subsp. *clivicola* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. scapis elatis et floribus labello relative parvo differt.

Typus: 400 m south-east from east end of CALM's Blackboy Picnic Ground, near Harvey, 33°05'S, 115°54'E, Western Australia, 25 September 1987, S.D. Hopper 6104 (*holo:* PERTH 01071114; *iso:* AD!, CBG!, K!, MEL!, NSW!, PERTH 02416271).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 77 (1992) and rev. 2nd edn with suppl., p. 77 (1998).

Plant usually solitary, occasionally in small clumps. *Leaf* 6–12 mm wide. *Scape* 30–50 cm tall. *Flowers* c. 7–10 cm across. *Sepals and petals* stiffly held and horizontal to obliquely downcurved basally, then with a lax vertical filamentous apex, linear-lanceolate in basal 1/7–1/4. *Dorsal sepal* 9–12 cm x 3–4 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 9–14 cm x 4–7 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, or obliquely downcurved for whole length, 6–10 cm x 2–4 mm. *Labellum lamina* narrowly cordate to cordate in outline when flattened, 15–25 x 7–10 mm; lateral lobes with marginal calli to 5 mm long. *Lamina calli* usually in 2 or 4 rows towards apex, to c. 1.5 mm tall. *Column* 12–17 x 6–8 mm.

(Figure 19M–S)

Selected specimens examined. WESTERN AUSTRALIA: on Cape Naturaliste Rd, 2.8 km NW of Dunsborough, 33°36'S, 115°04'E, 9 Sep. 1985, *S.D. Hopper* 4516A (PERTH 01193465); on the South Western Highway 400 m N of Talathalla Rd, c. 6.7 km N of Waroona, 32°48'S, 115°54'E, 17 Sep. 1985, *S.D. Hopper* 4604 (PERTH 01194623); E end of Bunkers Bay, 33°33'S, 115°03'E, 22 Sep. 1986, *S.D. Hopper* 5512 (PERTH 00873659); 400 m SE from E end of Blackboy Picnic Ground near the carpark at Department of Conservation and Land Management, Harvey, 33°05'S, 115°54'E, 25 Sep. 1987, *S.D. Hopper* 6104 (PERTH 01198734); Meelup–Eagle Bay, W of Busselton, 7 Sep. 1971, *S. Paust* 130 (PERTH 00278068); below Lesmurdie Falls, 21 Aug. 1954, *G.M. Storr s.n.* (PERTH 00913324).

Distribution and habitat. Known on the Darling Scarp between North Dandalup Dam and Collie, with a southern outlier near Dunsborough. Grows in moist Marri/Jarrah forest or adjacent to Bullich (*Eucalyptus megacarpa*) woodland, often near outcropping granite. Especially abundant after fire. The population near Dunsborough grows on coastal granitic slopes in low heath of *Hakea trifurcata*, *Daviesia horrida*, *Dodonaea ceratocarpa* and *Pimelea ferruginea*. Soils are acidic loams. (Figure 18B)

Flowering period. September to October.

Etymology. Named from the Latin *clivus* (slope of a hill) and the suffix *-cola* (dweller), alluding to the slopes of the Darling Scarp which the subspecies occupies.

Notes. A geographically restricted subspecies (Priority One) confined to the southern Darling Scarp and the northern Leeuwin–Naturaliste Ridge. *Caladenia longicauda* subsp. *clivicola* is distinguished from other subspecies of *C. longicauda* by its short column, its relatively small narrow labellum with slender marginal calli, and small lamina calli arranged in rows towards the apex. It does not appear to grow in local sympatry with other subspecies. Scattered populations of subsp. *eminens* occur nearby on the Darling Scarp in Wandoo woodlands. The well-watered forest slopes favoured by subsp. *clivicola* are also occupied by *C. uliginosa* subsp. *patulens*, which differs in its shorter fringe and projecting labellum.

Caladenia longicauda subsp. *clivicola* is most similar to subsp. *redacta*, from which it differs in its longer sepals and petals, usually taller scapes, more solitary habit and more westerly distribution. It is also similar to subsp. *calcigena*, but differs in its taller scapes (to 50 cm), its shorter labellum marginal calli, its lamina calli in uniform rows towards the labellum apex, and its occurrence in acidic loamy soils near exposed granite.

***Caladenia longicauda* subsp. *crassa* Hopper & A.P. Br., subsp. nov.**

A *Caladenia longicauda* subsp. *eminenti* (Domin) Hopper & A.P. Br. foliis crassioribus apicibus petalorum sepalorumque crassis et fimbria labelli longiore differt.

Typus: Cape Arid National Park on road to Yokinup Bay, 100 metres south-east of Merivale Rd, 33°48'S, 122°58'E, Western Australia, 10 September 1991, *S.D. Hopper* 8168 (*holo:* PERTH 01829076).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 83 (1992) and rev. 2nd edn with suppl., p. 83 (1998).

Plant solitary or in small clumps. *Leaf* 8–14 mm wide. *Scape* 25–50 cm tall. *Flowers* c. 7–14 cm across. *Sepals* and *petals* stiffly held, with an obliquely downcurved to vertically hanging filamentous apex, linear-lanceolate in basal 1/4–1/3. *Dorsal sepal* 6–10.5 cm x 3–5 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 7–10 cm x 6–10 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 5.5–8.5 cm x 3–6 mm. *Labellum lamina* cordate to broadly cordate in outline when flattened, 20–25 x 12–18 mm; lateral lobes with marginal calli to 8 mm long. *Lamina calli* usually in 4 or 8 rows towards apex, to c. 2 mm tall. *Column* 18–22 x 8–12 mm. (Figure 19T)

Selected specimens examined. WESTERN AUSTRALIA: Thomas River via Esperance, s.d., Anonymous s.n. (PERTH 00277541); Daniels Rd, N of Hopetoun, 31 Aug. 1963, A.S. George 5748 (PERTH 00272302); 3.4 km W of Drummond Track on Old Ongerup Rd, 3.2 km E of Susetta River, 33°48'S, 119°28'E, 4 Oct. 1984, S.D. Hopper 4192 (PERTH 00279447); Cape Arid National Park on road to Yokinup Bay, 100 m SE of Merrivale road, 33°48'S, 122°58'E, 10 Sep. 91, S.D. Hopper 8168 (PERTH 1829076); 1.5 miles [2.4 km] W of Cape Le Grand turnoff, 9 Sep. 1966, E.M. Scrymgeour 844 (PERTH 00278009).

Distribution and habitat. Occurs in winter-wet flats, swamps and waterlogged soils on granite outcrops near the coast from Esperance eastwards to Cape Arid National Park. Grows in open low mallee of *Eucalyptus tetragona*, *E. varia* subsp. *varia*, *E. tetraptera*, *E. uncinata*, *E. leptocalyx* and *Lambertia inermis* over low scrub and herbs (including *Tribonanthes australis*). Flowers best after fire. (Figure 18B)

Flowering period. September to early October.

Etymology. Named from the Latin *crassus* (thick), alluding to the relatively short thick filamentous apices of the petals and sepals of the subspecies.

Notes. *Caladenia longicauda* subsp. *crassa* is a geographically restricted subspecies confined to the winter-wet country of the broader Esperance region. It is similar to subsp. *eminens*, differing in its longer column, its usually broader labellum, and its shorter filamentous apex to the petals and sepals. Populations of *C. longicauda* near the coast west of Esperance may be intergrades of these two subspecies.

Caladenia longicauda subsp. *crassa* is distinguished from subsp. *australora* by its longer column, its uniformly larger flowers, broader labellum and broader lateral sepals. *Caladenia longicauda* subsp. *crassa* has not been recorded on calcareous soils, and occurs well to the east of the coastal calcareous habitat of subsp. *australora*.

Caladenia longicauda subsp. *crassa* hybridizes with *C. decora* at a number of locations.

***Caladenia longicauda* subsp. *eminens* (Domin) Hopper & A.P. Br., comb. nov.**

Caladenia longicauda Lindl. var. *eminens* Domin, *J. Proc. Linn. Soc., Bot.* 41: 253 (1912). – *Caladenia eminens* (Domin) M. Clements & D. Jones, *Austral. Orchid Res.* 1: 24 (1989). Type: 'Mallet, Western Australia, 1910, A. Dorrien-Smith s.n. (holo: K!)'.

Illustrations. L. Cady & E. Rotherham, *Australian Native Orchids in Colour*, plate 47, [as *Caladenia*

patersonii] (1970); A.S. George & H.E. Foote, Orchids of Western Australia, inside front cover, [as *Caladenia patersonii* var. *longicauda*] (undated); D. Jones, Native Orchids of Australia, p. 618 (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 62, [as *Caladenia patersonii* var. *longicauda*] (1984), 2nd edn, p. 82 (1992) and rev. 2nd edn with suppl., p. 82 (1998).

Plant in small to large clumps, or solitary. *Leaf* 5–16 mm wide. *Scape* 30–60 cm tall. *Flowers* c. 8–12 cm across. *Sepals and petals* stiffly held, with an obliquely downcurved to vertically hanging filamentous apex, linear-lanceolate in basal 1/6–1/4. *Dorsal sepal* 9–11 cm x 2–4 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 9–14 cm x 6–12 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 6–11 cm x 3–6 mm. *Labellum lamina* narrowly cordate to cordate in outline when flattened, 18–24 x 10–15 mm; lateral lobes with marginal calli to 6 mm long. *Lamina calli* usually in 2 or 4 rows towards apex, to c. 2 mm tall. *Column* 15–18 x 7–12 mm.

Selected specimens examined. WESTERN AUSTRALIA: Bobakine Hills, 15 km W of Northam, 31°40'S, 116°30'E, 30 Sep. 1986, J.J. Alford 439 (PERTH 00791202); Gold Holes, 5 km N along Chester Pass Rd from S boundary of Stirling Range National Park, 75 km N of Albany, 34°26'S, 118°05'E, 20 Sep. 1987, B. Cockman BC28 (PERTH 00875236); Young River crossing on Ravensthorpe–Esperance main road, 70 km W of Esperance, 8 Oct. 1968, N.N. Donner 2920 (PERTH 00271845); Gordon River bridge, 3 Oct. 1985, R. Heberle for R. Peakall 0048 (PERTH 00848840); 23 km NNE of Boyup Brook, 23 km ENE of Wilga Siding, on Moore Rogers Rd, 33°38'S, 116°29'E, 6 Oct. 1983, S.D. Hopper 3469 (AD, CBG, K, PERTH 00272760); Albany Highway, 800 m S of the Woodanilling turnoff, c. 33.3 km N of Kojonup, 33°32'S, 117°09'E, 20 Sep. 1985, S.D. Hopper 4631 (PERTH 01711563); Tenterden Nature Reserve, 34°22'S, 117°33'E, 15 Oct. 1986, S.D. Hopper 5714 (AD, CBG, PERTH 01208853); West River, 1.4 km S of the N boundary of Fitzgerald River National Park on Moir Rd, 33°48'S, 119°57'E, 30 Sep. 1987, S.D. Hopper 6164 (PERTH 01191349); Puntapin Rock c. 5 km ESE of Wagin, 33°16'S, 117°25'E, 14 Sep. 91, S.D. Hopper 8202 (PERTH 1829300); Bickley Valley, Darling Scarp, 31°57'S, 116°04'E, 22 Sep. 1987, K.F. Kenneally s.n. (PERTH 00849480); 11 km W of Manmanning, 9 Sep. 1972, B. & M. Smith s.n. (PERTH 00278084).

Distribution and habitat. Common and widespread from Moora south down the Darling Scarp in Wandoo woodlands to Harvey, and further south and east in Wandoo country to Frankland. Extends eastwards to near Ravensthorpe in Swamp Yate swamps and sheoak thickets. Preferred soils are usually loamy, often mixed with clay in Wandoo country. (Figure 18C)

Flowering period. September to October.

Notes. Clements (1989) elevated this taxon to full specific status with the comment that “This is the common large *Caladenia* with white flowers, that was previously known as *Caladenia patersonii* var. *longicauda*”.... “Illustrated on page 62 of Hoffman & Brown (1984) and on page 618 in Jones (1988)”. We consider subspecific status more appropriate (see notes under *C. longicauda* subsp. *longicauda*).

Caladenia longicauda subsp. *eminens* is the most widespread of the subspecies we recognise. While intergrading with subsp. *longicauda* where Wandoo woodland abuts Jarrah forest, subsp. *eminens* in pure populations differs in its shorter column, in usually forming large clumps, in its broader lateral sepals, and its usually more cordate labellum with the lamina calli towards the apex in 2 or 4 rows.

Caladenia longicauda subsp. *eminens* may also be confused with subsp. *australora*, but differs in its uniformly larger flowers with longer sepals, relatively broad labellum and lateral sepals, and its absence from near-coastal calcareous soils.

While similar to *Caladenia longicauda* subsp. *crassa*, subsp. *eminens* differs in its shorter column, its smaller narrowly cordate to cordate labellum when flattened, and its relatively longer filamentous apices to the petals and sepals. Populations of *C. longicauda* near the coast west of Esperance may be intergrades of these two subspecies.

In habitat and clump-forming habit, *C. longicauda* subsp. *redacta* is also similar to subsp. *eminens*, differing in its smaller floral size (see notes under that subspecies).

Clements (1989: 24) cited an isotype at Kew of *Caladenia longicauda* subsp. *eminens* collected at the same location and on the same date as the holotype. Clements annotated this "isotype" as such on a determinavit slip dated 24 August 1987. However, the sheet, with a single specimen on it, has an undated determinavit in K. Domin's hand annotated "*Caladenia patersonii* R.Br. ampl.". It is clear from this that Domin did not consider the specimen to be the same taxon as his *C. longicauda* var. *eminens*. The specimen has a leaf 8 cm x 6 mm, a single-flowered scape 27 cm tall. Its petals and sepals are all broken off and abbreviated, the dorsal sepal at least 55 mm long, petals at least 45 mm long, with the labellum only c. 8 mm wide and its marginal calli to 4 mm long. In our view, this specimen belongs to the taxon described below as *C. longicauda* subsp. *redacta*, and it clearly is not an isotype of *C. longicauda* var. *eminens*.

***Caladenia longicauda* subsp. *merrittii* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. petalis sepalisque praecipuae longis exilibusque differt.

Typus: 5.2 km south of Warner Glen Bridge on Warner Glen Rd, 34°10'S, 115°11'E, Western Australia, 13 October 1991, S.D. Hopper 8219 (*holo*: PERTH 01829386; *iso*: AD!, CBG!, MEL!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 81 (1992) and rev. 2nd edn with suppl., p. 81 (1998).

Plant solitary, rarely in small clumps. *Leaf* 6–10 mm wide. *Scape* 30–60 cm tall. *Flowers* c. 12–18 cm across. *Sepals and petals* stiffly held or lax apically, with an obliquely downcurved to vertically hanging filamentous apex, linear-lanceolate in basal 1/7–1/5. *Dorsal sepal* 9–12 cm x 2–4 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 9.5–15 cm x 3–6 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 9–11 cm x 2–4 mm. *Labellum lamina* narrowly cordate in outline when flattened, 20–28 x 9–11 mm; lateral lobes with marginal calli to 6 mm long. *Lamina calli* usually in 2 or 4 rows towards apex, to c. 1.5 mm tall. *Column* 18–22 x 7–10 mm.

Selected specimens examined. WESTERN AUSTRALIA: 2 km NNW of Nannup, 0.7 km W of Vasse Highway on Mowen Rd, 33°57'S, 115°46'E, 10 Oct. 1983, S.D. Hopper 3556 (CBG, PERTH 00271314); 9 km SE of Margaret River, 8 km NE of Witchcliffe, 34° 00'S, 115° 11'E, 9 Oct. 1984, S.D. Hopper 4284 (PERTH 00255866); 5 km NW of Margaret River, junction of O'Neil Rd and Engine Rd, 33°55'S, 115°05'E, 9 Oct. 1984, S.D. Hopper 4287 (PERTH 00279455); 5.2 km S of Warner Glen Bridge on Warner Glen Rd, 34°10'S, 115°11'E, 13 Oct. 91, S.D. Hopper 8219 (PERTH 1829386); Nillup, s.d., L. Horbury s.n. (PERTH 00278548); Pemberton–Nannup road, 1964, W. Rogerson 279

(PERTH 00278025).

Distribution and habitat. Known from a restricted area between Margaret River, Karridale and Nannup, growing in Jarrah/Marri forest or low woodland with *Persoonia longifolia*, Peppermint, *Xylomelum occidentale*, *Xanthorrhoea preissii*, *Acacia myrtifolia*, *Adenanthos barbigerus*, *Agonis parviceps*, *Conostylis laxiflora* and *Anigozanthos flavidus*. Associated orchids include *Caladenia ferruginea*, *C. brownii*, *C. attingens* and *C. flava*. (Figure 18B)

Flowering period. Late September to October.

Etymology. Named after Mr Wayne Merritt (1947–), landscape supplier, businessman, and keen member of the Western Australian Native Orchid Study and Conservation Group, who has helped us in finding many interesting orchid populations, and first alerted us about the presence of this large-flowered white spider orchid near the Blackwood River.

Notes. *Caladenia longicauda* subsp. *merrittii* is a distinctive subspecies, most similar to subsp. *longicauda*, but having exceptionally long and slender sepals, petals and labellum. Its long column is another feature. It flowers best after fire, and is difficult to locate in unburnt vegetation.

A rare hybrid of *Caladenia longicauda* subsp. *merrittii* and *C. ferruginea* has been collected (S.D. Hopper 8220, PERTH).

***Caladenia longicauda* subsp. *redacta* Hopper & A.P. Br., subsp. nov.**

A subspeciebus aliis *Caladenia longicauda* Lindl. floribus parvis segmentis fimbriae labelli gracilibus brevis ad 2–4 mm longis differt.

Typus: 13 km east of Mount Barker on Barrow Rd, 34°37'S, 117°48'E, Western Australia, 7 October 1990, S.D. Hopper 7890 (*holo:* PERTH 02212579; *iso:* AD!, CBG!, MEL!).

Illustration. N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 78 (1998).

Plant solitary, or in small to large clumps. *Leaf* 8–12 mm wide. *Scape* 20–40 cm tall. *Flowers* c. 6–8 cm across. *Sepals and petals* stiffly held and horizontal to obliquely downcurved basally, then with a lax vertical filamentous apex, linear-lanceolate in basal 1/5–1/4. *Dorsal sepal* 6–8 cm x 2.5–4 mm. *Lateral sepals* spreading basally, then obliquely downcurved to vertically hanging, 6–9 cm x 4–8 mm. *Petals* horizontal basally, then obliquely downcurved to vertically hanging, 5–8 cm x 2.5–4 mm. *Labellum lamina* narrowly cordate to cordate in outline when flattened, 15–18 x 7–10 mm; lateral lobes with marginal calli to 5 mm long. *Lamina calli* usually in 2 or 4 rows towards apex, to c. 1 mm tall. *Column* 12–15 x 6–8 mm. (Figure 20)

Selected specimens examined. WESTERN AUSTRALIA: c. 10.5 miles [17.7 km] NE of Denmark, 11 Oct. 1969, A.S. George 9698 (PERTH 00272272); 20 km NW of Darkin on the Quindanning–Darkan road and 1.4 km S of the Collie–Williams road, 33°13'S, 116°34'E, 27 Aug. 89, S.D. Hopper 7614 (PERTH 1829823); 9 km SW of Darkin on Gibbs Rd, 33°32'S, 116°39'E, 27 Aug. 89, S.D. Hopper 7619 (PERTH 1829866); c. 30 km NE of Boyup Brook on the Boyup Brook Rd, 12.3 km S of Cordering, 33° 40'S, 116°35'E, 27 Aug. 89, S.D. Hopper 7626 (PERTH 1829890); 13 km E of Mount Barker on

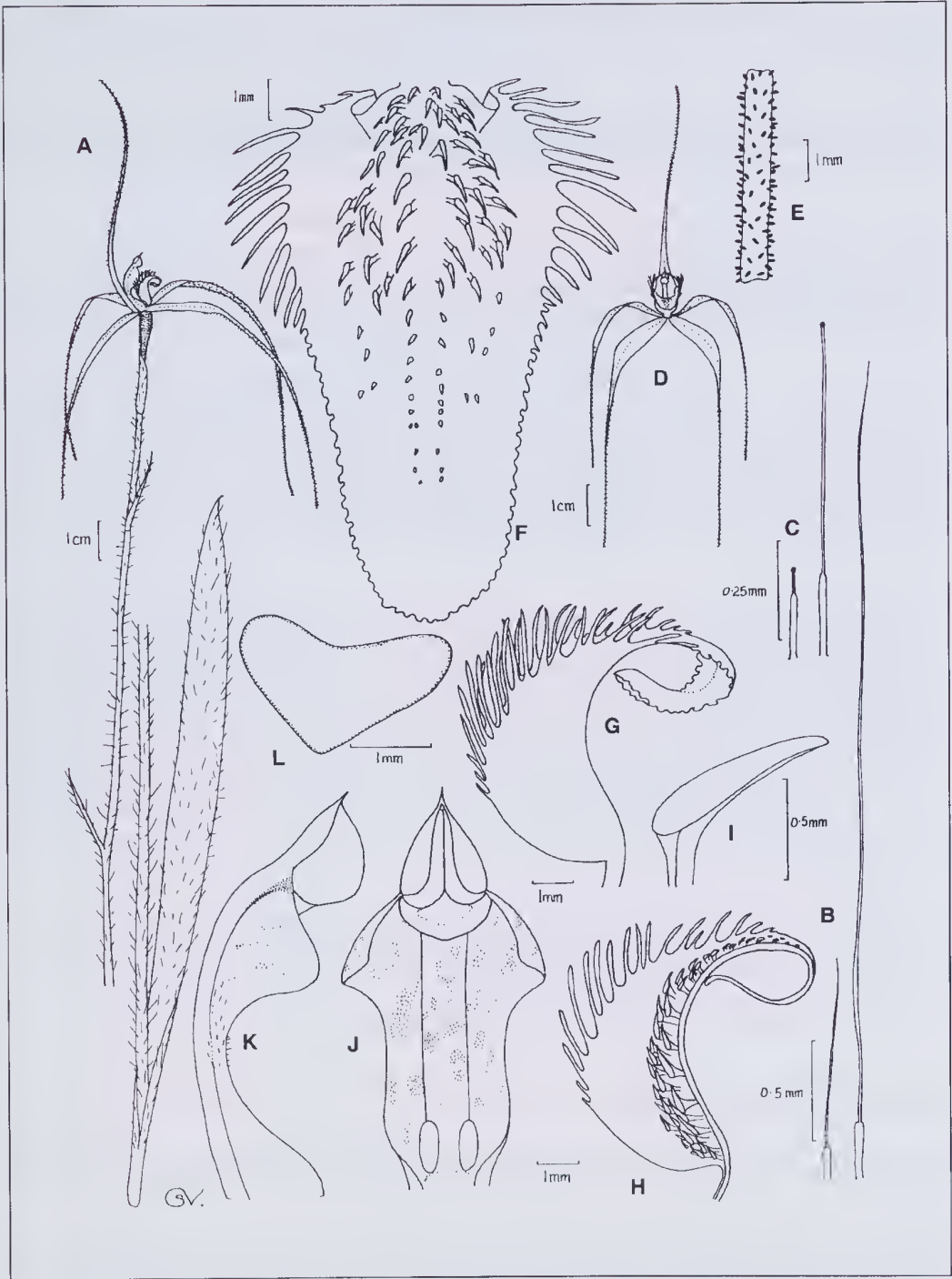


Figure 20. *Caladenia longicauda* subsp. *redacta* from the Darkan area, A – plant; B – hairs from lower scape; C – hairs from upper scape; D – flower from front; E – glands on sepals and petals; F – labellum from above; G – labellum from side; H – longitudinally sectioned labellum from side; I – calli; J – column from front; K – column from side; L – pollinia. Drawn by C. Vassilu.

Barrow Rd, 1 km N of Porongorups road, 34°37'S, 117°48'E, 7 Oct. 90, *S.D. Hopper* 7890 (PERTH 1828851).

Distribution and habitat. Known from winter-wet Wandoo flats and slopes over a 60 km range between Collie and Darkan, and further south-east in a disjunct occurrence near Mount Barker in a Swamp Yate swamp and adjacent Jarrah/Marri woodland. Soils are clay-loams. (Figure 18C)

Flowering period. Late September to October.

Etymology. Named from the Latin *redactus* (reduced, diminished), alluding to the flower size of the subspecies when compared with *C. longicauda* subsp. *eminens*.

Notes. A subspecies with geographically disjunct populations. Its occurrence in country between Mount Barker and Darkan requires further exploration. *Caladenia longicauda* subsp. *redacta* is characterized by a short column, a small labellum with short marginal calli and relatively short petals and sepals. It is similar to *C. longicauda* subsp. *clivicola*, differing in its shorter sepals and petals, its shorter stature, and its clump-forming habit. *Caladenia longicauda* subsp. *redacta* also occupies winter-wet Wandoo flats, whereas subsp. *clivicola* favours moist Jarrah/Marri forest or coastal granitic heath.

In habitat and habit *Caladenia longicauda* subsp. *redacta* is more similar to subsp. *eminens*, differing in its smaller floral size. These two subspecies intergrade in the Cordering area (e.g. *S.D. Hopper* 7626) and near Mount Barker (*A.P. Brown* 1018; *S.D. Hopper* 7890). Although flower size appears to be the main consistent difference between subsp. *redacta* and subsp. *eminens*, we consider this to be biologically important, because different-sized labella in other caladenias attract different pollinators (Stoutamire 1974, 1983), and probably also do so in these subspecies of *C. longicauda*. Moreover, subsp. *redacta* forms pure populations throughout its narrow range, intergrading with *C. longicauda* subsp. *eminens* only near its margins. Hence, subspecific status for *C. longicauda* subsp. *redacta* is advocated, rather than considering it merely a small-flowered variant of *C. longicauda* subsp. *eminens*.

Caladenia longicauda subsp. *redacta* hybridizes with *C. harringtoniae* (photo in Hoffman & Brown 1992: 78) and possibly with members of the *C. huegelii* complex.

***Caladenia longicauda* subsp. *rigidula* Hopper & A.P. Br., subsp. nov.**

Caladenia longicauda subsp. *insularis* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown (1992), Orchids of South-West Australia, 2nd edn, 73.

Caladenia christineae subsp. *insularis* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown (1995), Orchids of South-West Australia, revised paperback edn, 73.

Caladenia insularis Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown (1998), Orchids of South-West Australia, rev. 2nd edn with suppl., 73.

A subspeciebus aliis *Caladenia longicauda* Lindl. scapis brevibus et petalis sepalisque brevibus rigide effusis horizontaliter vel oblique differt.

Typus: Wittenoom Hills, 47 km north-east of Esperance, 33°28'S, 122°08'E, Western Australia, 8 October 1985, S.D. Hopper 4681 (*holo*: PERTH 01712217; *iso*: AD!, CBG!, K!, MEL!, NSW!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 72 (1992), revised paperback edn p. 72, and p. 73, [as *Caladenia christineae* subsp. *insularis*] (1995) and rev. 2nd edn with suppl., p. 72 and p. 73 [as *C. insularis*] (1998).

Plant solitary, or in small clumps. *Leaf* 6–20 mm wide. *Scape* 25–40 cm tall. *Flowers* c. 6–10 cm across. *Sepals and petals* stiffly held with an obliquely downcurved filamentous apex, linear-lanceolate in basal 1/4–1/3. *Dorsal sepal* 3.4–5 cm x 2–3 mm. *Lateral sepals* spreading basally, then obliquely downcurved, 3.4–6 cm x 4–6 mm. *Petals* horizontal basally, then barely downcurved, 2.8–5 cm x 2–4 mm. *Labellum lamina* narrowly cordate to cordate in outline when flattened, 7–20 x 8–10 mm; lateral lobes with marginal calli to 5 mm long. *Lamina calli* usually in 2 or 4 rows towards apex, to c. 1.5 mm tall. *Column* 12–16 x 6–10 mm.

Selected specimens examined. WESTERN AUSTRALIA: 20 km SW of Mt Ney, 33°30'S, 122°31'E, 9 Aug. 1980, A. Brown s.n. (PERTH 00262366); Kau Rocks, 33°25'S, 122°20'E, 1 Sep. 1984, M.A. Burgman & C. Layman MAB 3316 (PERTH 00231576); W of Ravensthorpe, below West River bridge on road to Esperance, 33°41'S, 119°40'E, 19 Aug. 1977, J. Dodd s.n. (PERTH 00914444); Sheoak Hill, SE of Mt Ragged, 33°37'S, 123°39'E, 14 Aug. 1980, A.S. George 16039 (PERTH 00277584); S end of Mt Ragged, 33°28'S, 123°28'E, 15 Aug. 1980, A.S. George 16071 (PERTH 00330353); Pine Hill, 33°18'S, 123°23'E, 16 Aug. 1980, A.S. George 16106 (PERTH 00261335); Juranda Rock Hole, 33°13'S, 123°27'E, 16 Aug. 1980, A.S. George per A. Brown 16120 (PERTH 00261432); Pallarup Rock Nature Reserve, Pallarup Rock, 44.5 km NNW of Ravensthorpe, 33°15'S, 119°45'E, 6 Sep. 1984, S.D. Hopper 4097 (PERTH 00271373); Mt Ney, 40 km N of Condingup, 33°24'S, 122°28'E, 12 Sep. 1991, S.D. Hopper 8183 (PERTH 1829149); Swan Lagoon Reserve, S of Grass Patch on old route to Goldfields, 20 Aug. 1978, D.R. Voigt 53pp (PERTH 00277096); near S end of Mt Ragged, 33°27'S, 123°29'E, 3 Sep. 1978, D.R. Voigt 78pp (PERTH 00329452).

Distribution and habitat. Poorly known, but found on or near inland granite outcrops and other winter-wet habitats from the Ravensthorpe district east to south-west of Balladonia. At Wittenoom Hills, *Caladenia longicauda* subsp. *rigidula* grows in lithic scrub and open low mallee of *Eucalyptus lehmannii* and *Acacia conniana*. Near Pine Hill, it grows in a granitic seepage area on the margins of a salt lake. On a near-coastal island east of Esperance, it grows in scrub of *Calothamnus*, *Leptospermum sericea*, *Anthocercis viscosa* and *Platysace rigida* in shallow granitic loam fringing sheet rock slopes, in some places within 3 m of the sea. (Figure 18A)

Flowering period. August to early October.

Etymology. Named from the Latin *rigens* (stiff, rigid) and the diminutive suffix *-ula*, alluding to the small stiffly-held flowers of the subspecies.

Notes. A subspecies distinctive in its short column and its small stiffly-held flowers with abbreviated petals and sepals. It occupies the most remote, easterly and semi-arid habitats in which the species occurs. The Esperance area has *Caladenia longicauda* subsp. *crassa* in densely vegetated swamps and in Swamp Yate woodlands on winter-wet flats. However, this subspecies has not been recorded close to *C. longicauda* subsp. *rigidula*, and is larger in most floral dimensions.

The geographically closest member of the *Caladenia longicauda* complex to subsp. *rigidula* is *C. cruscula*, a diminutive very short-segmented spider orchid confined to seeps associated with salt lakes. *C. longicauda* subsp. *rigidula* differs in its flowers usually larger with longer petals and sepals and a longer labellum (rare uppermost flowers of multiflowered scapes of *C. longicauda* subsp. *rigidula* may be smaller and overlap in dimensions with those of *C. cruscula*).

Previously we considered a disjunct insular population of *Caladenia longicauda* east of Esperance to be distinct, and tentatively placed it first as a subspecies of *C. longicauda* (Hoffman & Brown 1992), then as a subspecies of *C. christineae* (Hoffman & Brown 1995) and finally as a distinct species, *C. insularis* nom. inval. (Hoffman & Brown 1998). However, with further research and better collections available, it is now clear that this population falls within *C. longicauda* subsp. *rigidula* as circumscribed above.

Caladenia longiclavata E. Coleman, *Victorian Naturalist* 46: 196, f. (1930). Type: south-west of Western Australia, 1928–1929, s.coll. s.n. [unlabelled part of mixed collection as given for the type citation] (lecto: MEL 1002450 p.p., fide George (1971: 173)). Western Australia, September–October 1928, 1929, *Corker, Hill, Mitchell, E. Bryant* ex herb, *E. Coleman* s.n.

Illustrations. W. Nicholls, *Orchids of Australia*, plate 246 (1969); D. Jones, *Native Orchids of Australia*, p. 125, photo and line drawing (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 100 (1984), 2nd edn, p. 127 (1992) and rev. 2nd edn with suppl., p. 127 (1998).

Plant solitary or rarely in loose clumps. *Leaf* erect, linear, 9–18 cm x 7–20 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–35 cm tall. *Flowers* 1 or 2, c. 4–5 cm across, predominantly pale yellow to yellow-green with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal half, then abruptly narrowing for 1–5 mm before expanding to an osmophore; osmophore tumescent, 7–20 mm long on sepals, 5–12 mm long on petals, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 2.5–4.5 cm x 2–3.5 mm. *Lateral sepals* straight, spreading obliquely downwards, 2.5–4.5 cm x 5–8 mm. *Petals* spreading obliquely outwards and downwards, 2–3.5 cm x 2–3 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, yellowish-green with pale pink to pale red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2.5 mm wide; lamina cordate with an acute apex in outline when flattened, 13–18 x 7–14 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point scarcely to moderately curved upwards and terminated by obliquely ascending margins and calli; lateral lobes erect to obliquely ascending with entire margins near the claw, becoming fimbriate with slender to broad simple linear yellow-green marginal calli to 3 mm long which are slightly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* in 4 dense rows (lacking clear gaps between them) extending at least 3/4 the length of the labellum, dark maroon, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 12–15 x 7–10 mm, broadly winged, dull yellow-green to maroon. *Anther* c. 2.5 x 2.5 mm, yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 3 mm wide, dull yellow maroon. *Capsule* not seen. (Figure 21A–D)

Selected specimens examined. WESTERN AUSTRALIA: Walpole, 10 Nov. 1980, *A. Brown* s.n. (PERTH 00275166); Clackline Nature Reserve (18 km WSW of Northam), 8 Sep. 1985, *J. Brown & J.J. Alford* 3 (PERTH 00578401); Mundaring, 30 Aug. 1944, *C.A. Gardner* s.n. (PERTH 00333689);

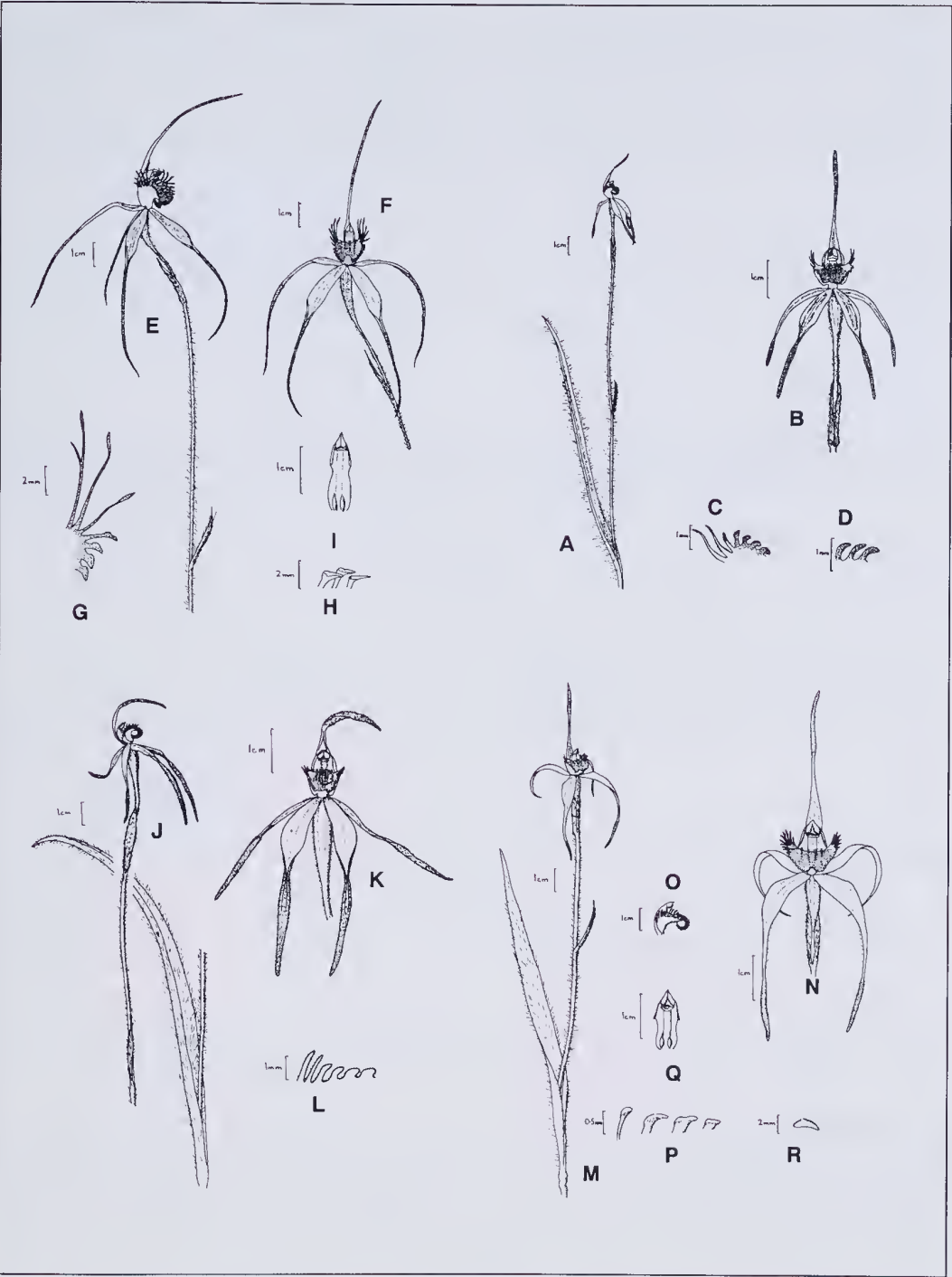


Figure 21. A–D. *Caladenia longiclavata* from Clackline Nature Reserve, A.P. Brown 125. A – plant; B – flower from front; C – labellum fringe; D – calli. E–I. *C. lorea* from Cockleshell Gully, A.P. Brown s.n. E – plant; F – flower from front; G – labellum fringe; H – calli; I – column from front. J–L. *C. magniclavata* from the Margaret River area, S.D. Hopper 4299. J – plant; K – flower from front; L – labellum fringe. M–R. *C. nivalis* from the Yallingup area, S.D. Hopper 4665. M – plant; N – flower from front; O – labellum and column from side; P – calli; Q – column from front; R – pollinia. Drawn by S.J. Patrick.

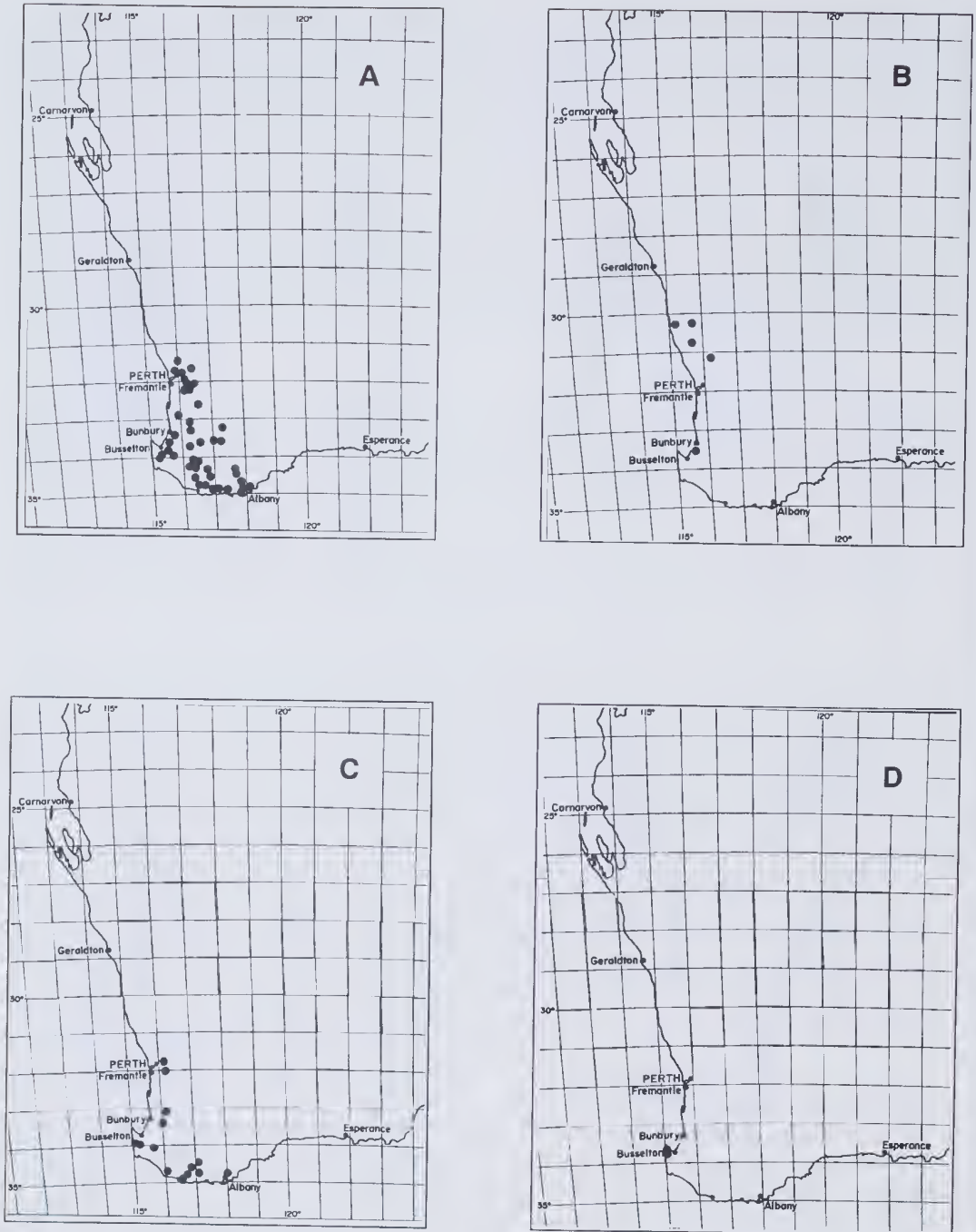


Figure 22. Distribution maps. A – *Caladenia longiclavata*; B – *C. lorea*; C – *C. magniclavata*; D – *C. nivalis*.

9 km E of Northcliffe off Muirillup Rd, 34°10'S, 116°40'E, 20 Oct. 1984, *G. Gardner s.n.* (PERTH 00333301); Takalarup Rd, 0.5 km E of Chester Pass, E end of Porongurups, 34°42'S, 117°58'E, 28 Sep. 1977, *A.S. George* 14942 (PERTH 00274674); Mowen Rd, c. 24.8 km NW of Nannup, 33°56'S, 115°37'E, 10 Oct. 1983, *S.D. Hopper* 3563 (PERTH 01195050); Deeside Coast Rd, 3.3 km N of Dean Rd, 34°47'S, 116°19'E, 29 Oct. 1987, *S.D. Hopper* 6302 (PERTH 01190881); Dryandra, 1 km S of village, 29 Aug. 1983, *G.J. Keighery* 6725 (PERTH 00261823); Wongamine Nature Reserve, 18 km E of Toodyay, 11 Aug. 1984, *G.J. Keighery* 7599 (PERTH 00560375).

Distribution and habitat. Widespread between New Norcia and Albany in mixed *Banksia*, sheoak (*Allocasuarina*) woodlands, or Jarrah forests and dense Karri forest, particularly after summer fire. Soils range from deep sand to heavy lateritic loams. (Figure 22A)

Flowering period. September to October.

Notes. *Caladenia longiclavata* was once thought (e.g. George 1971) to be a widespread variable species containing three varieties, var. *longiclavata*, var. *magniclavata* and var. *rhomboidiformis*. All are now considered distinct species (Clements 1989; present paper).

Caladenia longiclavata differs from all other members of the complex in its large flowers and longer labellum marginal calli. From *C. magniclavata*, *C. longiclavata* also differs in its shorter osmophores. *C. longiclavata* differs from *C. rhomboidiformis* in its petals with a prominent osmophore.

Caladenia arrecta is readily distinguished from *C. longiclavata* in its upswept petals and its calli in two pairs of rows with a clear gap between them. Apart from its larger flowers, *C. longiclavata* differs from *C. ensata* in its longer osmophores and its longer labellum marginal calli.

Caladenia longifimbriata Hopper & A.P. Br., *sp. nov.*

A speciebus aliis *Caladenia tentaculata* Schldl. floribus parvis, labello fimbria marginali maxima 10 mm longa, et labello callisque c. 5 mm longa differt.

Typus: Jerramungup, 33°56'S, 118°55'E, Western Australia, 20 September 1976, *A. Brown s.n.* (*holo:* PERTH 00236284).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 115, [as *C. tentaculata*] (1992) and rev. 2nd edn with suppl., p. 115 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 5–14 cm x 6–12 mm, pale green, abaxial side irregularly blotched with red-purple. *Scape* 14–24 cm tall. *Flowers* 1 or 2, c. 5–7 cm across, predominantly green to greenish-yellow with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal third, then abruptly narrowing and filiform before terminating in an osmophore; osmophore slightly tumescent, 8–12 mm long on sepals, absent or 2–3 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly to prominently incurved, 4–5 cm x 2–3 mm. *Lateral sepals* usually held below horizontal, rarely splayed forwards and downwards for the first c. 1 cm then curving inwards and obliquely upwards, terminating in a downcurved apex, 3.5–5 cm x 3–4 mm, base narrowly lunate. *Petals* straight, spreading obliquely downwards and backwards, 2.5–3.5 cm x 2–3 mm. *Labellum* prominently 3-lobed, 3-coloured, lateral lobes yellowish-green, central lamina and midlobe white

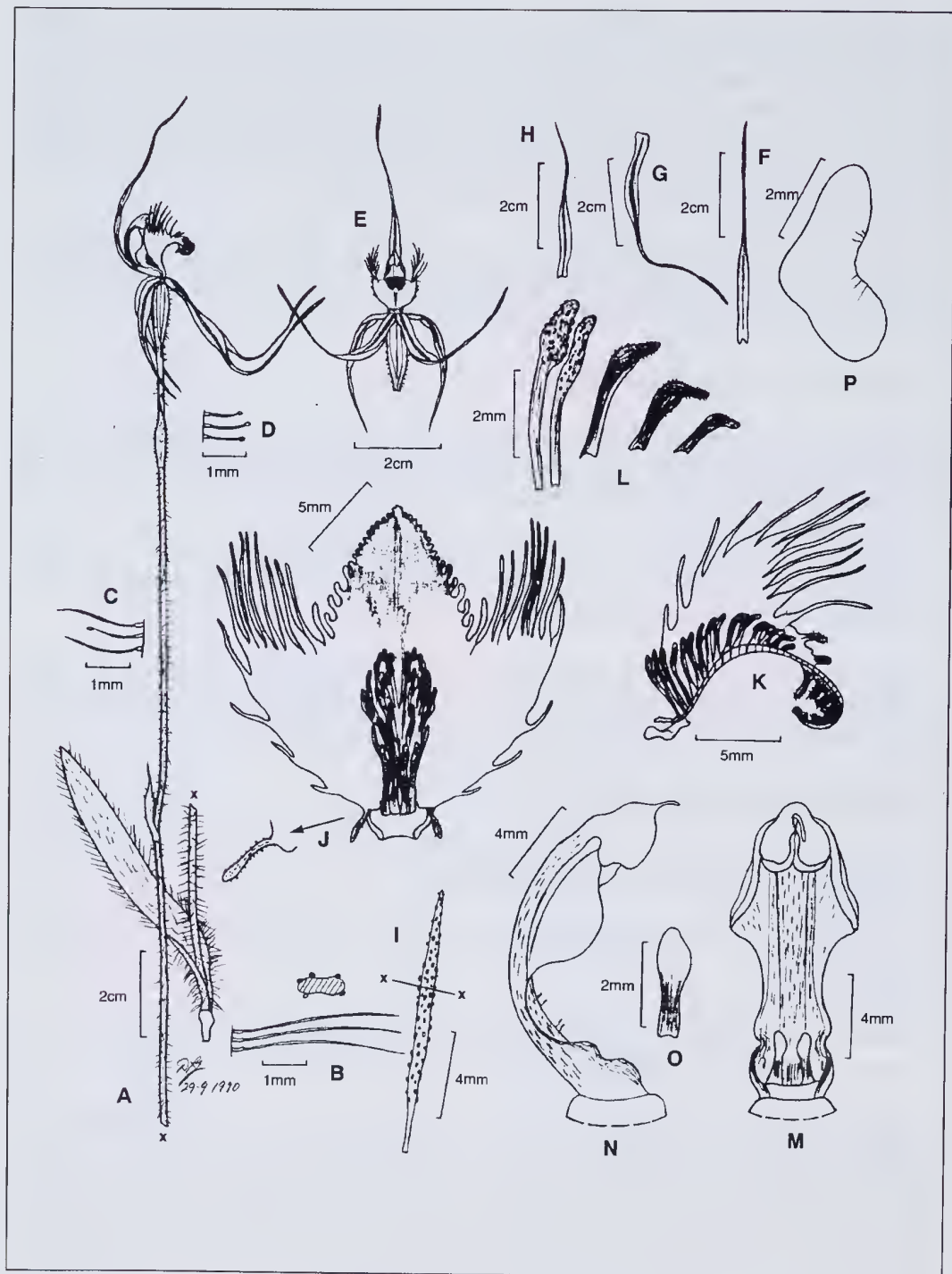


Figure 23. *Caladenia longifimbriata* from Jerramungup, R. Heberle s.n. A - plant; B - hairs on lower scape; C - hairs mid scape; D - hairs on upper scape; E - flower from front; F - dorsal sepal; G - lateral sepal; H - petal; I - osmophore; J - labellum from above; K - longitudinally sectioned labellum from side; L - calli; M - column from front; N - column from side; O - gland at base of column; P - pollinia. Drawn by D.L. Jones.

terminating in a uniformly dark maroon-purple recurved apex, loosely articulate on a claw c. 1.5 mm wide; lamina hastate with the lateral lobe apices curved forward and the midlobe triangular and acute in outline when flattened, 10–15 x 15–18 mm, basal third erect to obliquely ascending, distal 2/3 evenly curved downwards from horizontal with a shortly barely recurved apex, margins at widest point deeply curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire proximal margins for 2/3 of the length from the claw to the apex, then becoming fimbriate comb-like with slender linear yellowish-green calli to 10 mm long which are decrescent (sometimes abruptly) near midlobe; midlobe margins with short slender slightly forward-facing to downcurved obtuse simple calli decrescent towards the apex. *Lamina calli* densely congested down the middle, extending only half the length of the labellum (stopping well short of the dark maroon-purple apex), white with a dark purplish-maroon tip, golf stick-shaped, the longest c. 5 mm tall, decrescent towards the apex and becoming sessile. *Column* 10–12 x 5–6 mm, broadly winged, wings slightly undulate near base, pale yellow-green with pinkish blotches. *Anther* c. 3 x 3 mm, greenish-yellow. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 3 mm wide, dark dull maroon to pale green. *Capsule* not seen. (Figure 23)

Selected specimens examined. WESTERN AUSTRALIA: Jerramungup, 33°56'S, 118°55'E, Sep. 1978, R. Heberle s.n. (PERTH 00233447); Lort River Cascades area, Griffith Rd, c. 35 km WSW of Scaddan, 33°29'S, 121°20'E, 31 Aug. 1978, D.R. Voigt 51pp (PERTH 00233455, specimen a only).

Distribution and habitat. Known only from a few widely scattered localities between Jerramungup and Esperance. Inhabits Swamp Yate and mallee woodlands with Rock Oak adjacent to seasonal creeks. (Figure 24A)

Flowering period. Late August to September.

Etymology. Named from the Latin *longus* (long) and *fimbriata* (fimbriate), alluding to the elongate marginal calli on the labellum.

Notes. *Caladenia longifimbriata* is a poorly known species (Priority One) which, despite numerous searches in the recorded habitat, has rarely been seen since its discovery in 1976. It was seen again at the original site in 1978 and was also recorded from near the Oldfield River in 1995 and most recently near Jerramungup in 1998. It was originally believed by us to be conspecific with the South Australian King Spider Orchid *C. tentaculata*, but this view was questioned by D.L. Jones (pers. comm.). This prompted recent examination of fresh South Australian material from the type area by one of us (A.P. Brown), who has affirmed the specific distinctness of *C. longifimbriata*. The new species differs from *C. tentaculata* in its generally smaller flowers and labellum with more prominent marginal calli and longer central calli.

Caladenia longifimbriata grows with *C. falcata* near Jerramungup and with *C. attingens* subsp. *gracillima* between the Oldfield and Lort Rivers. *C. longifimbriata* differs from both these species in its tricoloured labellum lamina, with a white section between the maroon apex and the green lateral lobes, its longer marginal calli, and in its bicoloured central calli, that are white with maroon apices. While its flowers are similar in size to small specimens of *C. falcata*, *C. longifimbriata* differs in its less steeply upswept lateral sepals that have a drooping rather than erect, apex, and in its smaller column. *C. longifimbriata* has larger flowers with much longer labellum calli than those of *C. attingens*.

Caladenia lorea Hopper & A.P. Br., sp. nov.

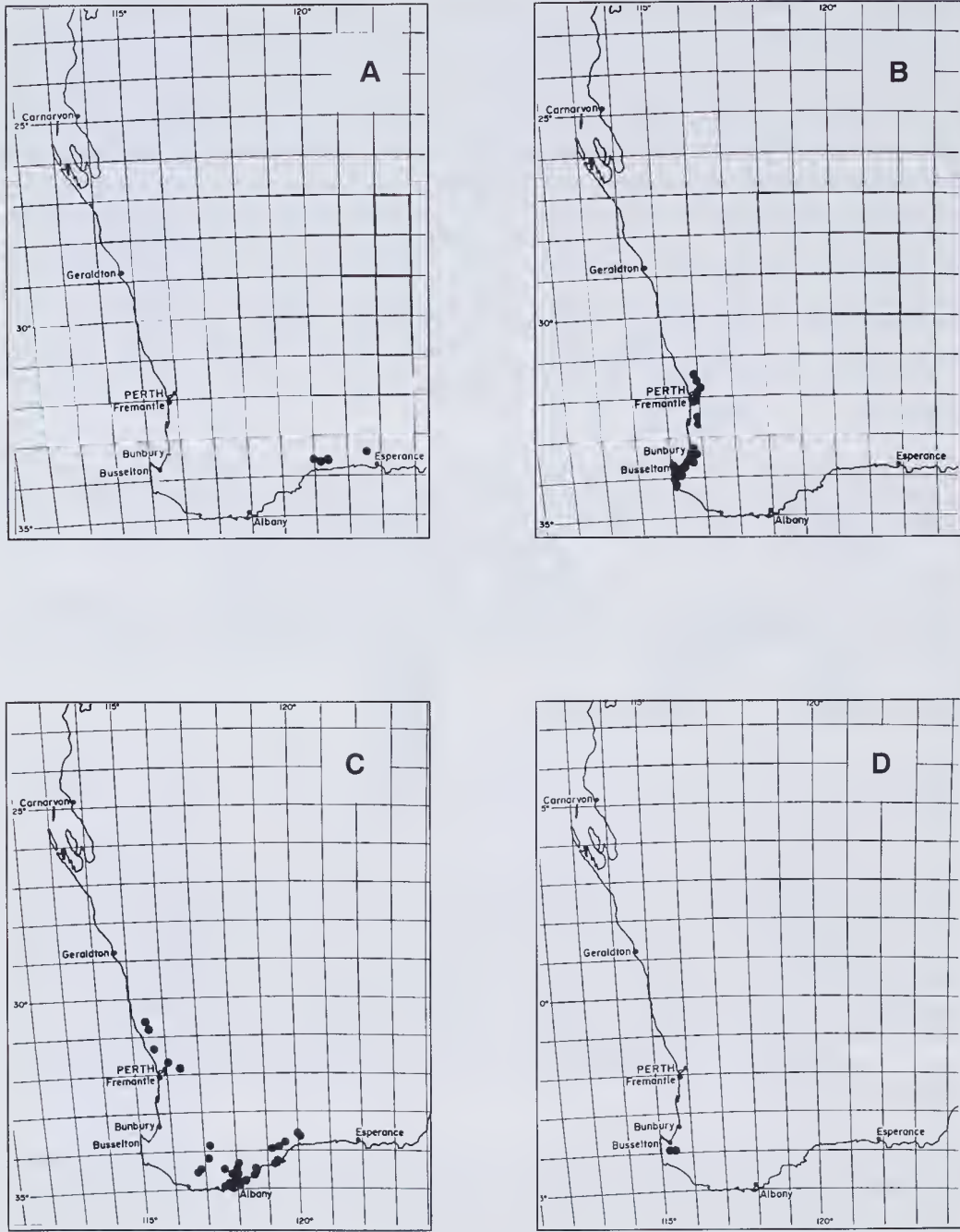


Figure 24. Distribution maps. A – *Caladenia longifimbriata*; B – *C. paludosa*; C – *C. pectinata*; D – *C. procera*.

A speciebus aliis affinibus *Caladenia huegelii* H.G. Reichb. petalis sepalisque plerumque cremeis suffusis atroroseus, pendulis apicibus filiformibus maxime longis vix tumidis differt.

Typus: Cockleshell Gully on north side of creek, between Jurien Bay road and Coorow–Greenhead road, 30°09'S, 115°06'E, Western Australia, 17 August 1985, A.P. Brown & S. van Leeuwen 197 (*holo*: PERTH 00900702; *iso*: CBG!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 94 (1992) and rev. 2nd edn with suppl., p. 94 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 12–20 cm x 7–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–40 cm tall. *Flowers* 1 or 2(3), c. 7–12 cm across, predominantly cream with variable suffusions, lines and spots of bright pink maroon; floral odour absent or faintly sweet. *Sepals and petals* stiffly held to lax, linear-lanceolate in basal quarter, then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 10–70 mm long on sepals, 10–50 mm long on petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–10 cm x 1.5–4 mm. *Lateral sepals* obliquely spreading and downcurved, 4–10 cm x 3–7 mm. *Petals* spreading to obliquely downcurved, 3.5–9 cm x 2–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, pinkish-white with darker pink to red radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate to cordate in outline when flattened, 17–27 x 10–15 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear pale maroon to cream (sometimes white-tipped) calli to 8 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, becoming cream on basal lamina, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 15–22 x 6–10 mm, broadly winged, creamy yellow with pale maroon-pink blotches. *Anther* c. 2–3 x 2–3 mm, greenish yellow with pink apex. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 3–4 mm wide, yellow-fawn. *Capsule* not seen. (Figure 21E–I)

Selected specimens examined. WESTERN AUSTRALIA: c. 25 km ENE of Jurien, 30°15'S, 115°10'E, 8 Aug. 1986, S.D. Hopper 5187 (PERTH 01208799); 0.5 km N of Wannamal Hall on Moora Rd North, c. 30 km NNW of Bindoon, 31°08'S, 116°03'E, 10 Sep. 1987, S.D. Hopper 5994 (PERTH 01208810); Minyulo Nature Reserve, c. 10 km WSW of Dandaragan, 30°42'S, 115°34'E, 10 Sep. 1987, S.D. Hopper 6009 (CBG, PERTH 01192418); Jurien Rd East, 0.4 km W of Munbinea Rd, c. 15 km E of Jurien Bay, 30°15'S, 115°10'E, 10 Sep. 1987, S.D. Hopper 6014 (CBG, PERTH 01208780); Boothendarra Hill, c. 60 km NW of Moora [probably not from this site], 30°16'S, 115°33'E, 10 Sep. 1987, S.D. Hopper 8018b (PERTH 01668587); c. 6 km W of Capel on Ludlow North Rd, 700 m N of Stirling Rd, 33°33'S, 115°30'E, 10 Oct. 91, S.D. Hopper 8207 (PERTH 1829327).

Distribution and habitat. Occurs from Leeman to the Gingin area north of Perth, in or on the margins of winter-wet depressions and drainage lines, under thickets and scrub or low woodlands of Marri, Wandoo and Flooded Gum. There is an outlying southern population in Tuart woodland near Capel. Soils are sandy loams or clays. (Figure 22B)

Flowering period. August to early October.

Etymology. Named from the Latin *loratus* (strap-shaped), alluding to the very long parallel-sided glandular osmophores on the sepals and petals.

Notes. An uncommon species sporadically distributed in woodlands in the northern sandplains, with a southern outlier near Capel. *Caladenia lorea* has the dark maroon labellum apex of the *C. huegelii* complex, but differs from all other species except *C. heberleana* in its long filiform sepals and petals which are only slightly swollen into apical osmophores. In this respect, *C. lorea* forms a link between the *C. huegelii* complex and members of the *C. longicauda* complex such as *C. excelsa*, which also has a dark maroon labellum apex, but differs in its taller scapes, much larger flowers, and preference for well drained soils. *C. lorea* closely resembles natural hybrids between *C. longicauda* and *C. arenicola* or *C. paludosa*, but forms pure morphologically uniform populations. *C. lorea* itself now hybridizes with *C. longicauda* when sympatric with it, and may also hybridize with *C. arenicola* in the southern part of its range.

The nearest relative of *Caladenia lorea* appears to be *C. heberleana*, from which *C. lorea* differs in its less swollen scarcely tumescent osmophores, the basal labellum lamina pinkish-white rather than white, with more prominent radiating stripes, and its northerly distribution in or on the margins of winter-wet depressions and drainage lines.

Caladenia magniclavata Nicholls, *Victorian Naturalist* 64: 135, f. (1947). – *Caladenia longiclavata* var. *magniclavata* (Nicholls) A.S. George, *Nuytsia* 1: 173 (1971). Type: Lesmurdie in the Darling Range, Western Australia, 14 September 1946, Mr and Mrs W.H. Nicholls s.n. (holo: MEL!).

Illustrations. W. Nicholls, *Victorian Naturalist* 64: 135, f. (1947). W. Nicholls, *Orchids of Australia*, plate 248 (1969); D. Jones, *Native Orchids of Australia*, p. 127, top right line drawing (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 128 (1992) and rev. 2nd edn with suppl., p. 128 (1998).

Plant solitary or rarely in loose clumps. *Leaf* erect, linear, 10–30 cm x c. 15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1 or 2(3), c. 4–5 cm across, predominantly pale yellow to yellow-green with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal third, then abruptly narrowing for 1–5 mm before expanding to an osmophore; osmophore tumescent, 15–25 mm long on sepals, 6–12 mm long, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–4.5 cm x 2–3 mm. *Lateral sepals* straight, spreading obliquely downwards, 3–4.5 cm x 4–6 mm. *Petals* spreading obliquely outwards and downwards, 2.5–3.5 cm x 2–3 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, yellowish-green with pale fawn radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina cordate with an acute apex in outline when flattened, 12–14 x 10–12 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli; lateral lobes erect to obliquely ascending with entire margins near the claw, becoming fimbriate with slender to broad simple linear yellow-green marginal calli to 4 mm long which are slightly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* in 4 dense rows (lacking clear gaps between them) extending at least 3/4 the length of the labellum, dark maroon, golf stick-shaped, the longest c. 1 mm tall, decrescent towards apex and becoming sessile. *Column* 12–14 x 6–8 mm, broadly winged, dull yellow-green to maroon. *Anther* c. 2 x 2 mm, yellow. *Pollinia*

c. 2 mm long, yellow. *Stigma* c. 2 mm wide, dull yellow maroon. *Capsule* not seen. (Figure 21J–L)

Selected specimens examined. WESTERN AUSTRALIA: Richardson Rd, W of Northcliffe, 34°38'S, 116°03'E, 16 Oct. 1985, A. Brown s.n. (PERTH 00905933); E side of Frankland River, Muirs Highway, 34°29'S, 116°54'E, 2 Nov. 1977, A.S. George 15014 (CBG, PERTH 00282405); Broke Inlet near Camfield Townsite, 12 Oct. 1969, A.S. George 9723 (PERTH 00274240); Frankland River, Nov. 1978, R. Heberle s.n. (PERTH 00274275); 1.3 km E of the N end of pine plantation along Bussell Highway, c. 16 km S of Margaret River, 34°06'S, 115°07'E, 9 Oct. 1984, S.D. Hopper 4299 (PERTH 01191918); 100 m E of North Rd on Mowen Rd, 22 km E of Margaret River, 33°57'S, 115°19'E, 10 Oct. 1984, S.D. Hopper 4301 (PERTH 00792888); Mt Franklin Rd, c. 0.2 km NE of the Thompson Rd turnoff, c. 18 km N of Walpole, 34°50'S, 166°43'E, 16 Oct. 1986, S.D. Hopper 5743 (CBG, PERTH 01196138).

Distribution and habitat. Found between Albany and Nannup with rare, scattered occurrences northwards to Bindoon. Usually found in heavier soils in dense Jarrah and Karri forest. (Figure 22C)

Flowering period. Late September to October.

Notes. There has been confusion as to the identity of this species, with George (1971) regarding it as a variety of *Caladenia longiclavata* and confusing it with our new species *C. arrecta*, an interpretation that was followed by Clements (1982), Hoffman & Brown (1984) and Woolcock & Woolcock (1984). Jones (1988) regarded *C. magniclavata* as a species rather than a variety but similarly confused it with *C. arrecta* in his description and colour photograph but not in the line drawing.

However, Nicholls (1947, 1969) illustrated and accurately described the diagnostic features of *Caladenia magniclavata* compared to *C. longiclavata*—its more robust habit, smaller more prominently pectinate labellum, the sepals and petals with a more prominent osmophore, often fully half their length, with the petals drawn as stiffly spreading outwards below horizontal. These diagnostic characters were highlighted when Nicholls (1969, plates 246–248) illustrated fresh specimens of *C. longiclavata*, *C. magniclavata* and *C. arrecta* (the latter referred to as a form of *C. longiclavata* from the deep shade of the Karri forest).

We have examined the holotypes of *Caladenia magniclavata* and *C. longiclavata* at MEL, and concur with Nicholls that these species are distinct. *C. magniclavata* occurs mainly in Karri and southern Jarrah forests between Albany and Augusta. The holotype was collected by Mr and Mrs Nicholls in 1946 in the Darling Range at Lesmurdie “in limited numbers in gravelly ironstone country, amongst heavy scrub of the jarrah forest”.

***Caladenia nivalis* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinibus *Caladenia huegelii* H.G. Reichb. floribus albidis apice labelli atomarroninea, et labello rigido carnosio in sectione complanata, fimbria segmentorum atomarroninorum validorum ad 3 mm longis differt.

Typus: On rocky knoll just south of Sugarloaf Rock car park, in Leeuwin–Naturaliste National Park, c. 9 km north of Yallingup, 33°34'S, 115°00'E, Western Australia, 27 September 1985, S.D. Hopper 4665 (*holo:* PERTH 01707043; *iso:* AD!, CBG!, K!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 98 (1992) and rev. 2nd edn with suppl., p. 98 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 10–18 cm x 4–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 12–20 cm tall. *Flowers* 1–2(3), c. 5–8 cm across, predominantly white, rarely pale pink, with occasional deeper pink suffusions, the osmophores dark fawn and the labellum apex rich rose pink to red; floral odour unknown. *Sepals and petals* stiffly held, linear-lanceolate in basal quarter, then abruptly narrowing to a long-acuminate apex; osmophore tumescent, 12–25 mm long on sepals, absent from petals, dark fawn, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–5.5 cm x 3–4 mm. *Lateral sepals* spreading and slightly downcurved, 3.5–5.5 cm x 5–7 mm. *Petals* slightly ascending to somewhat downcurved, 3–5 cm x 4–5 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, white to pale pink, occasionally with deeper pink radiating stripes, terminating in a uniformly rich rose pink to red recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate in outline when flattened, 18–25 x 10–12 mm, with a prominently elongated midlobe, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending margins and calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with thickened acuminate linear dark rose pink to red calli to 2.5 mm long which are gradually decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 9/10 the length of the labellum, dark rose pink to red, sometimes white at base, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 14–16 x 5–10 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 3–4 x 3–4 mm, dark maroon to yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 4 mm wide, dark yellow-green. *Capsule* not seen. (Figure 21M–R)

Selected specimens examined. WESTERN AUSTRALIA: 250 m NW of gravel pit, N of Sugarloaf Rock, 33°33'S, 115°01'E, 23 Sep. 1986, S.D. Hopper 5527 (PERTH 00874116); N end of Smiths Beach, Yallingup, W of parking bay, 33°39'S, 115°01'E, 24 Sep. 1986, S.D. Hopper 5542 (PERTH 00874132); 2 km S of Canal Rocks, 33°41'S, 114°59'E, 25 Sep. 1986, S.D. Hopper 5547 (PERTH 00874159); Moses Rock, Cape Leeuwin–Naturaliste National Park, 21 Sep. 1988, G.J. Keighery 10478 (PERTH 01123351); Sugarloaf Rock Lookout, Cape Naturaliste, 26 Aug. 1985, G.J. Keighery 8370 (PERTH 00792691).

Distribution and habitat. Occurs from Cape Naturaliste south to Moses Rock on the Leeuwin–Naturaliste Ridge, a range of 25 km. It is always within a few kilometres of the coast, growing on granite outcrops in low coastal heath or rarely Peppermint low woodland. (Figure 22D)

Flowering period. September to October.

Etymology. Named from the Latin *nivalis* (snowy), alluding to the pure white colouration of the upper basal lamina of the petals and sepals in most individuals.

Notes. A locally common coastal species with a very restricted habitat and narrow geographical range. *Caladenia nivalis* is distinct in its striking white and red colouration, its stiffly splayed petals and sepals with a downcurved apex, and its flattened labellum with a white basal lamina. It has the shortest labellum marginal calli of any Western Australian member of the *C. huegelii* complex, a feature shared with allied eastern Australian taxa such as *C. reticulata* Fitz., *C. calcicola* G.W. Carr and *C. fitzgeraldii* Rupp. Thus, *C. nivalis* may be a relictual species that has diverged little from the ancestral stock that ranged across Australia before the east was isolated from the south-west. This could be tested by DNA gene sequencing and the development of a molecular phylogeny for the *C. huegelii* complex.

Caladenia nivalis is not known to hybridize with any other co-occurring species, including

C. applanata, *C. infundibularis*, *C. attingens*, *C. flava* and *C. latifolia*.

***Caladenia paludosa* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinibus *Caladenia huegelii* H.G. Reichb. petalis sepalisque brevibus rigide effusus, sepalis clavis parvis brunneis et fimbria labelli segmentorum atromarroninorum gracilium vel robustorum ad 6 mm longorum apicibus albidis amplificatis differt.

Typus: 5.5 km south along Bussell Hwy from Bunbury bypass, 33°24'S, 115°37'E, Western Australia, 22 September 1985, S.D. Hopper 4649 (*holo*: PERTH 01707035; *iso*: AD!, CBG!).

Illustrations. E. Pelloe, *West Australian Orchids*, frontispiece colour plate No. 3, [as *Caladenia pectinata*] (1930); D. Clyne, *Australian Ground Orchids*, front cover and p. 99, [as *Caladenia huegelii*] (1970); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 104 (1992) and rev. 2nd edn with suppl., p. 104 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–30 cm x 5–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–50 cm tall. *Flowers* 1–3(4), c. 5–8 cm across, predominantly greenish yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 10–25 mm long on sepals, absent from petals, light to dark brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4–6 cm x 3–5 mm. *Lateral sepals* spreading and downcurved, 3.5–6 cm x 4–5 mm. *Petals* obliquely ascending, 3–4.5 cm x 2.5–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, greenish-yellow with dull maroon to red radiating stripes, terminating in a shiny uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate in outline when flattened, 17–25 x 8–16 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending margins and calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender clubbed linear dark maroon (sometimes white-tipped) calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 17–20 x 6–12 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* 2.5–4 x 2.5–4 mm, dark maroon. *Pollinia* c. 2.5–3 mm long, yellow. *Stigma* c. 3–4 mm wide, dark yellow-green. *Capsule* not seen. (Figure 25A–D)

Selected specimens examined. WESTERN AUSTRALIA: Bunbury by-pass road, c. 1 km SE of Bunbury, W of Bunbury Rifle Range, 32°21'S, 115°39'E, 14 Oct. 1985, A. Brown s.n. (PERTH 00905941); 2.5 km SW of Busselton, E side of Queen Elizabeth Avenue behind Water Board, 33°40'S, 115°19'E, 9 Oct. 1983, D. Cooper s.n. (PERTH 00273309); Forestdale, between school and golf course, 18 Oct. 1979, H. Demarz D7628 (PERTH 00272809); 4 km SSW of Yallingup on Caves Rd, 1.3 km S of Wyadup turnoff, 34°41'S, 115°01'E, 5 Oct. 1983, S.D. Hopper 3447 (CBG, PERTH 00273252); edge of Boonanaring Creek, c. 12 km NNE of Gingin, 31°15'S, 115°53'E, 17 Sep. 1986, S.D. Hopper 5489 (PERTH 01711652); Fish Rd Reserve, 100 m E of Action Park Rd, 10 km SE of Busselton, 33°44'S, 115°24'E, 25 Oct. 1987, S.D. Hopper 6250 (PERTH 01208330); lower Helena River Valley, 15 Oct.

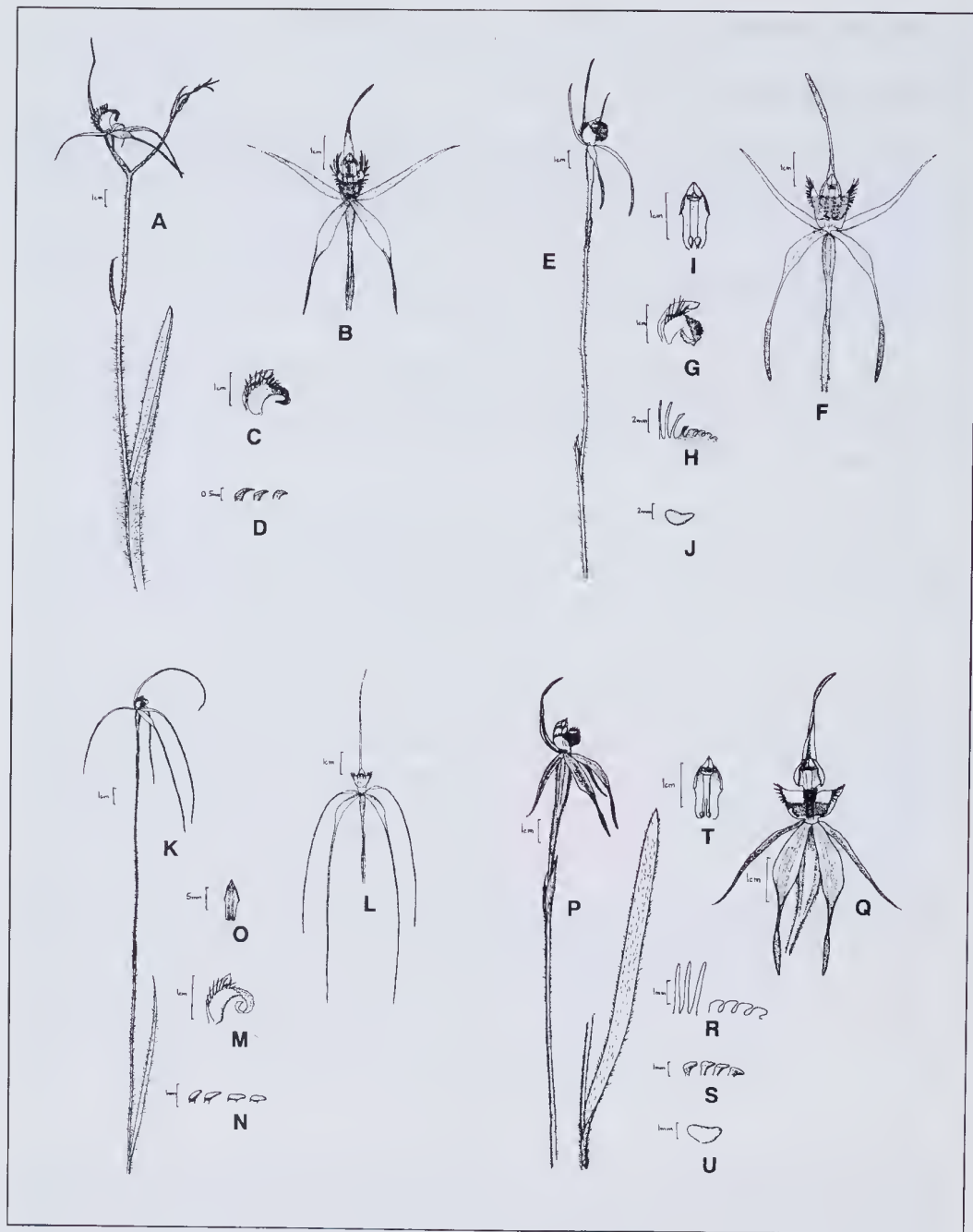


Figure 25. A-D. *Caladenia paludosa* from the Gingin area, S.D. Hopper 5489. A - plant; B - flower from front; C - labellum and column from side; D - calli. E-J. *C. pectinata* from the Kojonup area, A.P. Brown 258. E - plant; F - flower from front; G - labellum and column from front; H - labellum fringe; I - column from front; J - pollinia. K-O. *C. pholcoidea* subsp. *pholcoidea* from the Augusta area, S.D. Hopper 4741. K - plant; L - flower from front; M - labellum and column from side; N - calli; O - column from front. P-U. *C. rhomboidiformis* from the Witchcliffe area, S.D. Hopper 3438. P - plant; Q - flower from front; R - labellum fringe; S - calli; T - column from front; U - pollinia. Drawn by S.J. Patrick.

1977, *J. Seabrook* 376 (PERTH 00272779).

Distribution and habitat. Ranges from the Gingin area south to near Gracetown on the Leeuwin–Naturaliste Ridge, growing in winter-wet flats and swamps beneath sedges, low heath or paperbark (*Melaleuca*) or eucalypt low woodland. (Figure 24B)

Flowering period. Late September to early December.

Etymology. Named from the Latin *paludosus* (marshy, swampy, boggy), alluding to the winter-wet habitat preferred by the species.

Notes. A locally common species of patchy distribution. *Caladenia paludosa* appears to be allied to the Threatened species *C. viridescens*, which has somewhat smaller flowers with paler petals and sepals, its lateral sepals often splayed out horizontally, a narrower less cordate labellum, and a preference for well-drained rather than swampy habitats. *C. paludosa* may also be more distantly allied to *C. applanata* and *C. pectinata*, both of which have more robust flowers with the petals and lateral sepals less widely splayed, larger osmophores on the lateral sepals, and inhabit drier well-drained soils.

There appear to be races in *Caladenia paludosa*, with populations near Bunbury and Busselton not as darkly coloured as those near Perth and Gingin. The taxonomic status of these races needs further study.

Caladenia pectinata R.S. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 44: 352–353 (1920). *Type:* lower King River, near Albany, Western Australia, 17 September 1919, *Dr & Mrs Rogers s.n.* (*lecto:* AD 96919568! *fide* George 1971). *Excluded syntypes:* York, *O.H. Sargent s.n.* (AD!, PERTH); Cork Swamp, near Perth, Western Australia, 3 September 1907, *Mrs Tapp s.n.* (AD!); Swan View, Western Australia, 13 September 1906, *Mrs W.E. Cooke s.n.* (AD!).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia – cultivation and natural history*, colour plate c opposite p. 2, [as *Caladenia* species ‘Green Spider Orchid’] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 111 (1992) and rev. 2nd edn with suppl., p. 111 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 15–30 cm x c. 20 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 35–50 cm tall. *Flowers* 1–3, c. 6–7 cm across, predominantly reddish (rarely greenish) yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 10–35 mm long on the sepals, absent from the petals, light to dark brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4–7 cm x 2–5 mm. *Lateral sepals* spreading and downcurved, 4–7 cm x 6–9 mm. *Petals* obliquely ascending, 3.5–4.5 cm x 3–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, pale pinkish yellow with dull maroon to red radiating stripes, terminating in a dull uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate to cordate in outline when flattened, 18–25 x 12–18 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending margins and calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acute linear dark maroon to golden yellow calli to 8 mm long which are abruptly decrescent near midlobe;

midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3–3/4 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 17–22 x 8–10 mm, broadly winged, creamy yellow with red-pink blotches. *Anther* c. 4 x 4 mm, yellow with maroon markings. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 4 mm wide, dark yellow-green. *Capsule* not seen. (Figure 25E–J)

Selected specimens examined. WESTERN AUSTRALIA: Towerlup Rd between Frankland and Kojonup, c. 48 km S of Kojonup, c. 48 km S of Kojonup, 26.9 km S of Jingalup, 34°12'S, 116°59'E, 17 Oct. 1985, A. Brown 258 (PERTH 00906492); Stirling Range National Park, 300 m NE of Moingup Spring, Chester Pass Rd, 75 km N of Albany, 34°25'S, 118°06'E, 20 Sep. 1987, B. Cockman BC47 (PERTH 00875198); 31 km N of Frankland on Kojonup Rd, 34°11'S, 116°59'E, 3 Oct. 1978, A.S. George 15248 (AD, CBG, K, MEL, PERTH 00238392); 4.3 km S of old Ongerup Rd on Hamersley Drive, 26 km ESE of Fitzgerald, 33°45'S, 119°45'E, 4 Oct. 1984, S.D. Hopper 4187 (PERTH 00302147); 200 m W of Bremer Bay Caravan Park, 34°25'S, 119°23'E, 6 Oct. 1984, S.D. Hopper 4229 (PERTH 00238376); 11.3 km S of Mettlers Rd on Cape Riche Rd, 8 km W of Cape Riche, 34°37'S, 118°42'E, 6 Oct. 1984, S.D. Hopper 4243 (AD, CBG, PERTH 00238333); S side of Beermullah West Rd, 0.2 km past Nine Mile Swamp Rd turnoff, c. 16 km NNW of Gingin, 31°14'S, 115°47'E, 18 Sep. 1987, S.D. Hopper 6083 (PERTH 01190849); Frankland River–Muir's Highway Bridge, N of Muir's Highway c. 300 m and W of river, 20 Oct. 1990, W. Jackson BJ180 (PERTH 01699970); Mt Manypeaks, 40 km E of Albany, 25 Aug. 1986, G.J. Keighery 8657 (PERTH 00873063); Lake William, West Cape Howe, 30 km W of Albany, 30 Sep. 1986, G.J. Keighery 9831 (PERTH 00873071); Maylands, Sep. 1912, M.E. Wood B2318 (PERTH 00232564).

Distribution and habitat. Found between the Fitzgerald River National Park and Rocky Gully, with rare scattered populations west to Boyup Brook and north to Cataby on the Swan Coastal Plain. Preferred habitat is sandy-clay loams in winter-wet flats and moist run-off areas around granite outcrops. Flowering is more prolific following summer fires. (Figure 24C)

Flowering period. Late September to October.

Notes. The correct identity of this species has been confused from its original description (Rogers 1920) right up to the most recent relevant publications (Clements 1989). Dr Rogers included at least three species among the syntypes of *Caladenia pectinata*. The lectotype from Lower King River is labelled "type" in Rogers' hand, and matches the protologue in almost all respects. Sargent's collection from York and Mrs Tapp's collection from Cork Swamp near Perth match the lectotype and we consider them to be typical *C. pectinata*. However, the other excluded syntypes, collected by Mrs Cooke from Swan View, are a mixture of *C. huegelii* and *C. arenicola*.

The inclusion of *Caladenia huegelii* specimens probably accounts for Rogers' erroneous description of the labellum fringe of *C. pectinata* as having segments which are "often forked or dentate at their free extremities". Typical *C. pectinata* always has entire fringe segments, whereas *C. huegelii* often has one or two short bifurcations. The selection by George (1971) of the Rogers specimen as lectotype is also supported by other parts of the protologue which provides many other characters that fall outside the range of typical *C. huegelii* (e.g. "flowers ...yellowish", "lateral sepals ...total length about 5 cm, dilated part (i.e. clubs) about 2 cm, greatest breadth about 5 mm", and "petals...about 3.5 cm long and about 4 mm in the widest part").

Authors subsequent to Rogers have almost invariably mistaken *Caladenia pectinata* for other members of the *C. huegelii* complex. Pelloe (1930) gave a brief description that was not diagnostic, and in a colour plate opposite page 1 illustrated *C. paludosa* under the name *C. pectinata*. Erickson (1965) described and illustrated (colour plate opposite front page) *C. arenicola* under the name *C. pectinata*. Nicholls (1969) modified Rogers' (1920) original description so that it encompassed the size and shape of both typical *C. huegelii* and typical *C. pectinata*. Nicholls (1969: plate 252a) illustrated *C. applanata* under the name *C. pectinata*. Going on the description of *C. pectinata* written by Nicholls, it seems likely that he was following Rogers in considering *C. huegelii* and *C. pectinata* to be variants of the same species.

George (1971) regarded *Caladenia pectinata* as conspecific with *C. huegelii*, stating that "although *C. huegelii* is a variable species, the types of *C. pectinata* and *C. ferruginea* agree quite well with the Huegel collection". Given that the syntypes of *C. pectinata* include three species, and those of *C. huegelii* include two, we find George's treatment of this complex too broad to be useful. Pocock (1972) attempted (unsuccessfully) to describe the entire *C. huegelii* complex under the name *C. pectinata*, and used as an illustration (plate 33) a photograph of *C. brownii*.

Rye (1987) provided a description of *Caladenia arenicola* under the name *C. pectinata*, but noted (on the advice of SDH) that there were three variants, and that the variant from the Perth Region that she described differed from typical *C. pectinata* and was to be recognized as a subspecies. Jones (1988) described and illustrated a variant of *C. decora* under the name *C. pectinata*. He sought comments on the manuscript from us in 1986, and we saw no need then to change his treatment because we considered that *C. decora* was a subspecies of *C. pectinata*. Subsequent research has convinced us that these taxa are indeed distinct species. Clements (1989) recognized *C. pectinata*, made the erroneous claim that he was the first to nominate the lectotype (George 1971 had already done so), and cited Hoffman & Brown's (1984) illustration of *C. decora* (on page 110) as an example of *C. pectinata* (based on our above comments to Jones in 1986).

Hoffman & Brown (1992) described and illustrated typical *Caladenia pectinata*, but included *C. procera* in their distribution notes. *C. pectinata* differs from *C. procera* in its shorter scapes, its petals and sepals with variable suffusions, lines and spots of dull maroon to pink, its shorter labellum and its smaller column.

Caladenia pholcoidea* Hopper & A.P. Br., *sp. nov.

A *Caladenia longicauda* Lindl. floribus pallido-flavidis sepalis longioribus et fimbria brevioris labelli differt.

Typus: Muirs Highway, c. 1.5 km west of Thompsons Rd, 34°27'S, 116°37'E, Western Australia, 14 December 1984, A.P. Brown 185 (*holo*: PERTH 0170 6985; *iso*: AD!, CANB!).

Plant solitary, or in loose clumps in large colonies. *Leaf* erect, linear, 10–20 cm x 6–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1–3(4), c. 5–6 cm across, pale yellow to cream with occasional faint suffusions, lines and spots of dull maroon; floral odour faintly, sweet. *Sepals and petals* stiffly held, with a downcurved to lax pendulous apex, linear-lanceolate in basal 1/6–1/10, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal*

basally erect, then curving forward and downwards, 5–14 cm x 2.5–3 mm. *Lateral sepals* spreading and downcurved to vertical, 4.5–15 cm x 4–5 mm. *Petals* horizontal basally, then downcurved to vertical, 3.5–10.5 cm x 3–4 mm. *Labellum* obscurely 3-lobed, uniformly cream except for dull maroon radiating stripes near basal marginal calli, stiffly articulate on a claw c. 1.5 mm wide; lamina narrowly cordate in outline when flattened, 15–20 x 8–10 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending margins and calli; lateral lobes erect with entire margins within 2 mm of the claw, becoming fimbriate with slender acuminate to slightly obtuse narrowly fusiform dull maroon white-tipped calli to 6 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, pink, with a white base and tip, golf stick-shaped, the longest c. 1 mm tall, decrescent towards apex and becoming sessile. *Column* 10–14 x 5–7 mm, winged, creamy yellow with dull maroon blotches. *Anther* c. 2.5 x 2.5 mm, pale greenish yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide, yellow-green. *Capsule* not seen.

Distribution and habitat. Ranges from Augusta to Greenbushes and Manypeaks, adjacent to seasonally wet sites such as river banks, swampy flats, and granite outcrops, or in winter-wet swampy flats. Grows in forest of Jarrah, Marri, paperbarks (*Melaleuca* spp.) and banksias, but flowers well only after the dense understorey has been burnt. Soils are usually sandy loams. The Manypeaks population is a disjunct outlier at the foot of a large granite outcrop.

Flowering period. October to January.

Etymology. Named after the cosmopolitan Daddy Long Legs spider, *Pholcus phalangeroides*, alluding to the elongate sepals and petals contrasting with the small labellum.

Notes. *Caladenia pholcoidea* is an uncommon species that is widely but sporadically distributed through the high rainfall south-western forests. Several specimens of this species were sent by various collectors to R.S. Rogers in Adelaide earlier this century, but Dr Rogers did not formally name them as a new taxon. *C. pholcoidea* is similar to *C. longicauda* subsp. *albella*, but differs in its pale yellow flowers with relatively longer sepals, its shorter labellum fringe, and its much later flowering season. It also resembles *C. christineae*, with which it sometimes grows, but differs again in its pale yellow colouration, much longer sepals and petals, and later flowering season. The only other member of the *C. longicauda* complex that flowers as late as *C. pholcoidea* is *C. serotina*, which has shorter more robust and colourful petals and sepals, and a larger labellum than *C. pholcoidea*. These two species occasionally hybridize near Augusta.

The short labellum fringe of *Caladenia pholcoidea* is possibly a primitive feature, found in other Western Australian species such as *C. uliginosa* and *C. christineae*, and also common in eastern States members of the *C. patersonii* complex.

Near Augusta, *Caladenia pholcoidea* shows morphological variation associated with distinctive habitats. We recognise two subspecies which are distinguished in the following key:

Key to subspecies of *Caladenia pholcoidea*

1. Flowers pale yellow with a cream labellum. Lateral sepals 8–15 cm.
Flowering period late November to January subsp. **pholcoidea**

1: Flowers cream, rarely creamy yellow. Lateral sepals 4.5–9 cm.

Flowering period October to mid November subsp. **augustensis**

Caladenia pholcoidea* Hopper & A.P. Br. subsp. *pholcoidea

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 64, [as *Caladenia* sp.] (1984), 2nd edn, p. 87, [as *C. pholcoidea*] (1992) and rev. 2nd edn with suppl., p. 87 (1998).

Plant solitary, rarely in loose clumps. *Flowers* pale yellow with a cream labellum. *Sepals and petals* with a lax pendulous apex. *Dorsal sepal* 7.5–14 cm long. *Lateral sepals* 8–15 cm long. *Petals* 5.5–10.5 cm long. (Figure 25K–O)

Selected specimens examined. WESTERN AUSTRALIA: 2.5 km SW of Augusta, 1 km S of Golf Course Rd, 34°20'S, 115°08'E, 26 Oct. 1984, *E. Chapman s.n.* (PERTH 00404330); W of Valley of Giants, W of Pemberton, 7 Dec. 1957, *A.S. George s.n.* (PERTH 00232068); Mt Manypeaks, Nov. 1978, *R. Heberle s.n.* (PERTH 00232092); 5 km S of Margaret River on Bussell Highway, parking bay on E side of road, 33°59'S, 115°05'E, 11 Dec. 1985, *S.D. Hopper* 4740 (PERTH 00907987); E boundary of Leeuwin–Naturaliste National Park, W of Augusta, 34°20'S, 115°07'E, 11 Dec. 1985, *S.D. Hopper* 4741 (AD, CBG, K, MEL, PERTH 00908010); old Alexandra bridge on bank of Blackwood River, 34°10'S, 115°12'E, 11 Dec. 1985, *S.D. Hopper* 4744 (PERTH 00909130); Chesapeake Rd, 1 km SE of Shannon River bridge, c. 35 km NW of Walpole, 34°51'S, 116°23'E, 8 Dec. 1987, *S.D. Hopper* 6327 (PERTH 01201433); just off Appadene Rd, W of Manjimup, 34°15'S, 116°05'E, 27 Nov. 1989, *B. Jackson s.n.* (PERTH 1828517); Albany, 12 Dec. 1962, *R. Oliver s.n.* (PERTH 00232084).

Distribution and habitat. Ranges from Augusta to Greenbushes and Manypeaks, usually adjacent to seasonally wet sites such as river banks, swampy flats, and granite outcrops. Grows in forest of Jarrah, Marri, paperbarks (*Melaleuca* spp.) and banksias, but flowers well only after the dense understorey has been burnt. Soils are usually sandy loams. The Manypeaks population is a disjunct outlier at the foot of a large granite outcrop. (Figure 27A)

Flowering period. Late November to January.

Notes. This is the more widespread of the two subspecies of *Caladenia pholcoidea*, but is locally less abundant. It is noteworthy in its ability to flower in the absence of fire. It prefers better drained soils and flowers later than subsp. *augustensis*.

***Caladenia pholcoidea* subsp. *augustensis* Hopper & A.P. Br., subsp. nov.**

A subspeciebus typica petalis sepalisque semipendulis luteolis rare albis, et postea floriscentia differt.

Typus: near Augusta, Western Australia, 11 December 1985, *S.D. Hopper* 4741 (*holo:* PERTH 00908010; *iso:* AD!, CBG!, K!, MEL!).

Illustrations: N. Hoffman & A. Brown, *Orchids of South-West Australia*, rev. 2nd edn with suppl., p. 421 (1998).

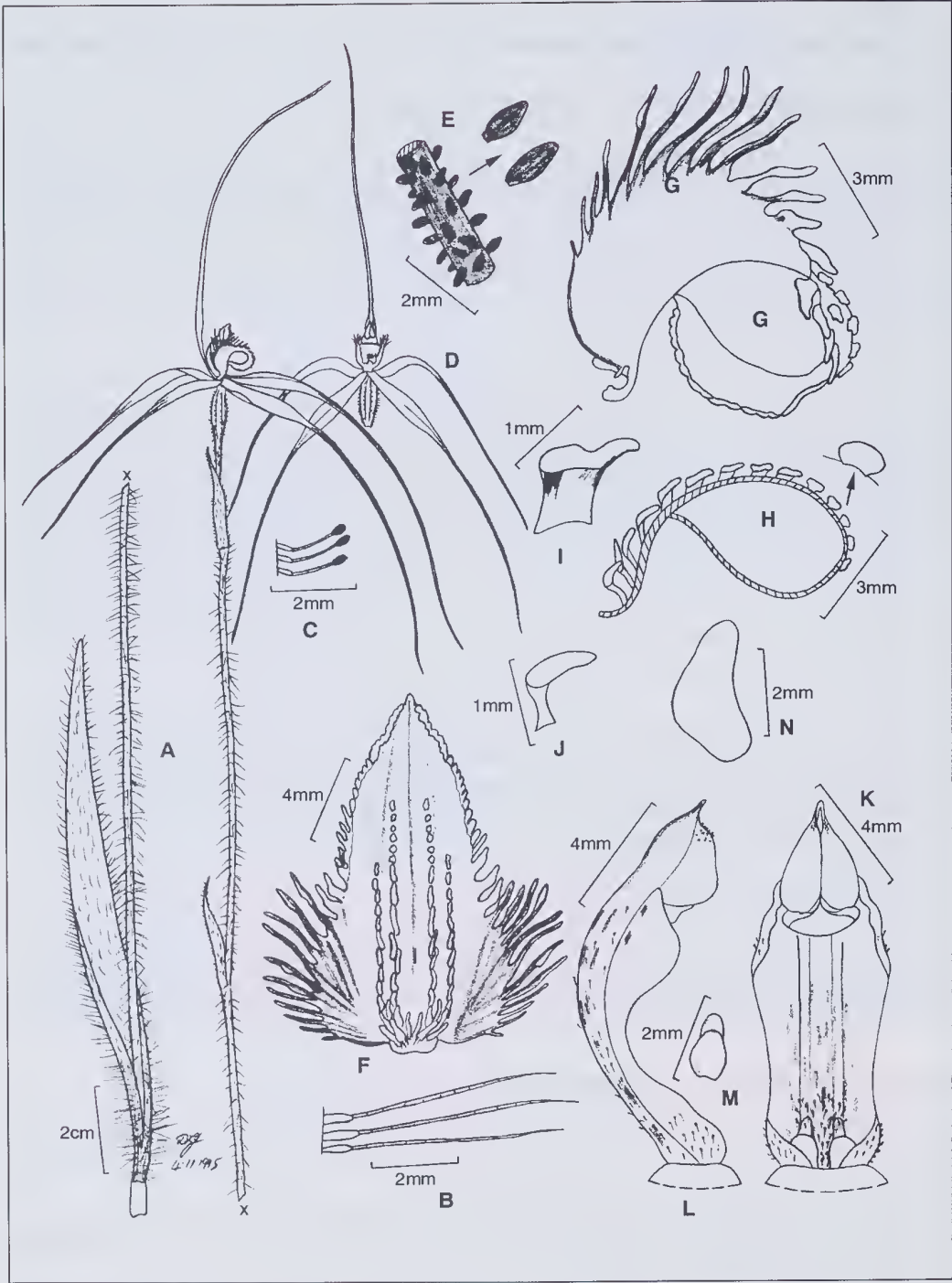


Figure 26. *Caladenia pholcoidea* subsp. *augustensis* from Augusta, C.J. French s.n. A – plant; B – hairs on lower scape; C – hairs on upper scape; D – flower from front; E - hairs on tepal apex; F – labellum from above; G – labellum from side; H – longitudinally sectioned labellum from side; I – labellum lamina callus; J – basal labellum lamina callus; K – column from front; L – column from side; M – glands at base of column; N – pollinia. Drawn by D.L. Jones.

Plant usually in loose clumps in large colonies. *Flowers* cream, rarely creamy yellow. *Sepals and petals* with a downcurved apex. *Dorsal sepal* 5–9 cm long. *Lateral sepals* 4.5–9 cm long. *Petals* 3.5–8 cm long. (Figure 26)

Distribution and habitat. A rare subspecies confined to a single winter-wet flat in the Augusta area, where it grows under dense paperbark (*Melaleuca cuticularis*) amongst low shrubs and sedges. Soils are sandy-clays. Flowers only after summer fire. (Figure 27B)

Flowering period. October to mid November.

Etymology. Named after the township of Augusta, near to which it is only known on present information.

Notes. This recently discovered subspecies was first brought to our attention by Greg Bussell in 1992. It is currently known from a single winter-wet flat near Augusta. In this area it was locally common in bush burnt the previous summer and was absent from adjacent unburnt bushland. *Caladenia pholcoidea* subsp. *augustensis* grows near subsp. *pholcoidea* but differs in its paler cream flowers, shorter petals and sepals, and marginally earlier flowering period, which has been recorded only after summer fire.

Caladenia procera Hopper & A.P. Br., *sp. nov.*

A speciebus aliis *Caladenia huegelii* H.G. Reichb. affinibus scapis robustis 35–70 cm altis, et petalis sepalisque viridi pallido-citrinis differt.

Typus: Bussell Highway, c. 500 m south of Carburnup Store, 33°42'S, 115°11'E, Western Australia, 17 October 1986, S.D. Hopper 5785 (*holo:* PERTH 01029266).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, rev. 2nd edn with suppl., p. 423 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 10–30 cm x 6–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 35–70 cm tall. *Flowers* 1–4, c. 5–9 cm across, predominantly greenish lemon yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal quarter (sepals) or third (petals), then abruptly narrowing (sepals) or tapering (petals) to a long-acuminate apex; osmophore prominently tumescent, 15–25 mm long in sepals, absent from petals, yellow-brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 5–7 cm x 4–5 mm. *Lateral sepals* spreading and downcurved, 5.5–6.5 cm x 6–8 mm. *Petals* obliquely ascending, 3.5–4.5 cm x 4.5–5 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, greenish lemon yellow with pale pink to fawn radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2.5 mm wide; lamina narrowly cordate to cordate in outline when flattened, 22–30 x 15–20 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear greenish lemon yellow calli to 10 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse hooked dull maroon calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4–4/5 the length of the labellum, dull maroon, sometimes white at base, golf stick-shaped, the longest

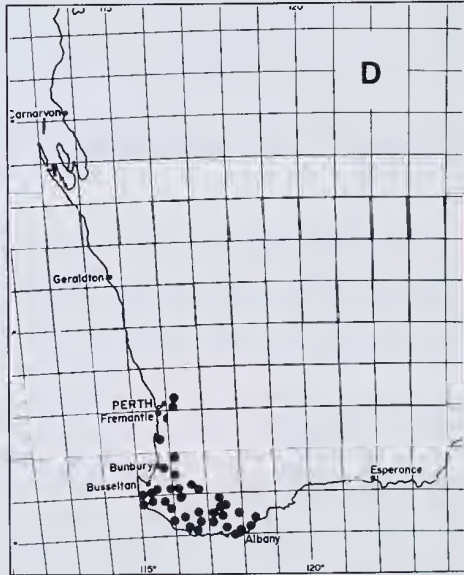
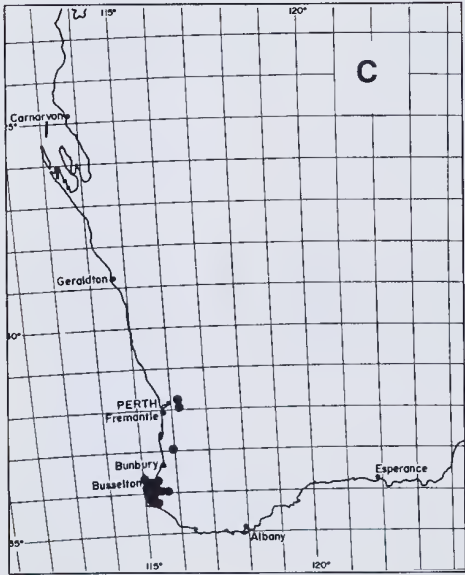
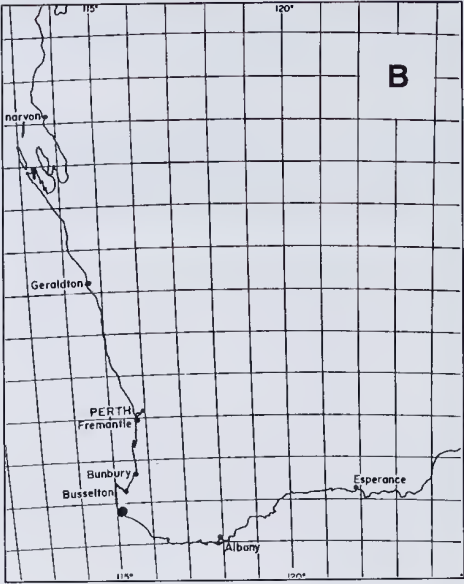
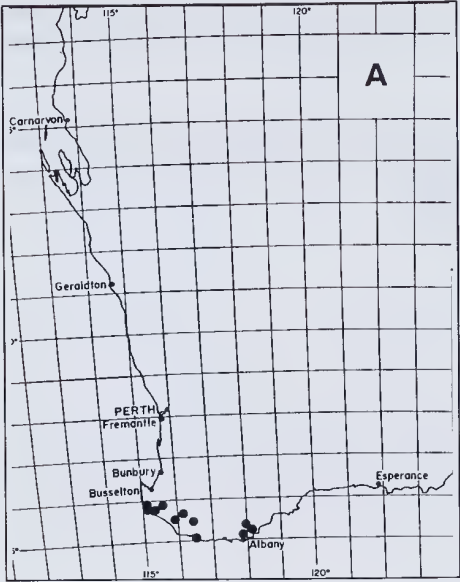


Figure 27. Distribution maps. A – *Caladenia pholcoidea* subsp. *pholcoidea*; B – *C. pholcoidea* subsp. *augustensis*; C – *C. rhomboidiformis*; D – *C. serotina*.

c. 3 mm tall, decrescent towards apex and becoming sessile. *Column* 22–25 x 13–15 mm, broadly winged, greenish lemon yellow with pale pink to fawn blotches. *Anther* c. 4 x 4 mm, pink. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 4 mm wide, dark yellow-green. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: Carbanup, c. 16 km WSW of Busselton on Busselton–Augusta road, 33°42'S, 115°12'E, 14 Oct. 1985, A. Brown 250 (PERTH 00905399); Busselton, Sep. 1929, E. Coleman s.n. (PERTH 00255920); Busselton area, 24 Sep. 1967, R. Jennings s.n. (PERTH 00915424).

Distribution and habitat. Confined to a small range south-west of Busselton, growing in Jarrah, Marri and Peppermint woodland on alluvial sandy-clay loam flats with *Anigozanthos manglesii*. (Figure 24D)

Flowering period. September to October.

Etymology. Named from the Latin *procus* (very tall, high) alluding to the scape height compared with that of *C. pectinata*.

Notes. A locally common but highly restricted species closely related to *Caladenia pectinata* and *C. decora*, differing from both in its consistently greenish lemon yellow sepals, petals and basal labellum lamina, and its somewhat taller scapes. *C. procera* also differs from *C. decora* in its consistently ascending petals lacking an osmophore, and its broader more acute column wings. It has a taller broader column and somewhat longer labellum than *C. pectinata*. *C. procera* hybridizes with *C. attingens*.

Caladenia rhomboidiformis (E. Coleman) M. Clements & Hopper, *Australian Orchid Research* 1: 30 (1989). – *Caladenia dilatata* R. Br. var. *rhomboidiformis* E. Coleman, *Victorian Naturalist* 46: 197 (1930). – *Caladenia longiclavata* E. Coleman var. *rhomboidiformis* (E. Coleman) A.S. George, *Nuytsia* 1(2): 173 (1971). *Type citation*: Busselton, Capel, Forest Grove, Augusta, Boyup Brook, Mundaring, Waterloo, Western Australia, September–October 1928, 1929, E. Corker, C. Hill, S. Mitchell & E. Bryant s.n. *Type*: south-west of Western Australia, 1928–1929, s.coll.s.n. [unlabelled part of a mixed collection as given for the type citation] (*lecto*: MEL 1002422 p.p., *fide* George (1971: 173))

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 104, [as *C. longiclavata* var. *rhomboidiformis*] (1984), 2nd edn, p. 125 (1992) and rev. 2nd edn with suppl., p. 125 (1998).

Plant solitary or rarely in loose clumps. *Leaf* erect, linear, 12–18 cm x c. 20 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–45 cm tall. *Flowers* 1 or 2, c. 4–6 cm across, predominantly pale yellow, yellow-green or maroon with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal half, the sepals abruptly narrowing for 2–7 mm beyond basal half before expanding to an osmophore; osmophore tumescent, 2–10 mm long on sepals, absent from petals, light brown to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3–4 cm x 2.5–3.5 mm. *Lateral sepals* straight, spreading obliquely downwards, 2.5–4 cm x 4–7 mm. *Petals* spreading obliquely outwards and downwards, 2–3 cm x 3–3.5 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, yellowish-green to white sometimes with pale maroon radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina cordate with an acute apex in

outline when flattened, 15–20 x 10–14 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending margins and calli; lateral lobes slightly ascending with entire margins near the claw, becoming fimbriate halfway to midlobe with slender to broad simple linear yellow-green marginal calli to 2 mm long which are gradually decrescent towards midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked dark maroon calli decrescent towards the apex. *Lamina calli* densely aggregated, rarely in 4 discernible rows (lacking clear gaps between them) extending at least 4/5 the length of the labellum, dark maroon, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 14–17 x 8–10 mm, broadly winged, dull yellow-green to maroon. *Anther* c. 3 x 3 mm, yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 3 mm wide, dull yellow maroon. *Capsule* not seen. (Figure 25P–U)

Selected specimens examined. WESTERN AUSTRALIA: S of Yallingup, 8 Oct. 1967, A.S. George 9205d (PERTH 00934496); Karridale, 12 Oct. 1977, R. Heberle s.n. (PERTH 00308447); 1.5 km NE of Witchcliffe 7.5 km SSE of Margaret River 3 km E of Bussell Highway, 34°01'S, 115°07'E, 5 Oct. 1983, S.D. Hopper 3438 (PERTH 00246921); 2 km NW of Dunsborough, 9 km SE of Cape Naturaliste, 33°35'S, 115°05'E, 5 Oct. 1983, S.D. Hopper 3453 (PERTH 00246549); Mowen Rd, c. 24.8 km NW of Nannup, 33°56'S, 115°37'E, 10 Oct. 1983, S.D. Hopper 3564 (PERTH 01195042); 22 km WNW of Nannup, junction of Mowen Rd and Jalbarragup Rd, 18 km SW of Jarrahwood, 33°55'S, 115°33'E, 10 Oct. 1984, S.D. Hopper 4303 (PERTH 00792918); on Cape Naturaliste Rd, 2.8 km NW of Dunsborough, 33°36'S, 115°04'E, 9 Sep. 1985, S.D. Hopper 4516b (PERTH 01193457); Haddleton Nature Reserve on W boundary at Granite Flatrock, 33°40'S, 116°35'E, 16 Oct. 1991, S.D. Hopper 8224 (PERTH 1829416).

Distribution and habitat. Mainly found in the Busselton–Augusta area, but also of scattered occurrence northwards to near Perth. Inhabits Jarrah forest and *Banksia*/sheoak (*Allocasuarina*) woodlands in deep sand and lateritic loams. (Figure 27C)

Flowering period. September to October.

Notes. *Caladenia rhomboidiformis* was first described by Edith Coleman in 1930 as a variety of *C. dilatata*. George (1971) removed it from that species and placed it with the closely related *C. longiclavata*. However, it differs from *C. longiclavata* and the related *C. magniclavata* in its petals lacking an osmophore, and its labellum lamina with almost horizontal lateral lobes and with shorter marginal calli. Recognizing these differences Clements & Hopper (1989) elevated *C. rhomboidiformis* to full species status.

Caladenia arrecta is also related to *C. rhomboidiformis* but is readily distinguished by its upswept petals with an osmophore and its calli in two pairs of rows with a clear gap between them. *C. rhomboidiformis* is a common species of the Busselton–Augusta area where it freely hybridizes with *C. citrina*.

***Caladenia serotina* Hopper & A.P. Br., sp. nov.**

A *Caladenia longicauda* Lindl. floribus plus coloratis petalis sepalisque saepissime rigide ferentibus et postea florescentia differt.

Typus: c. 16 km north of Manjimup on South Western Highway, 34°05'S, 116°11'E, Western Australia,

calli in 4 rows (sometimes towards apex up to 8, or 4 or 2 rows, or irregularly aggregated) extending at least 3/4 the length of the labellum, pale to dark maroon, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 13–22 x 7–10 mm, winged, greenish yellow with maroon blotches and suffusions. *Anther* c. 3.5–4.5 x 3.5–4.5 mm, maroon with yellowish suffusions. *Pollinia* c. 3–4 mm long, yellow. *Stigma* c. 3–4 mm wide, yellow-green. *Capsule* not seen. (Figure 28A–F)

Selected specimens examined. WESTERN AUSTRALIA: Byford, S of Armadale, 1 Nov. 1968, *Byrne* 2 (PERTH 00290475); N of Dinninup, Nov. 1983, *E. Chapman* s.n. (CANB, PERTH 00245577); 2.5 km SW of Augusta, c. 1 km S of Golf Course road, 34°20'S, 115°08'E, 26 Oct. 1984, *E. Chapman* s.n. (PERTH 00404349); just NW of Kulikup, 33°50'S, 116°40'E, 3 Nov. 1977, *A.S. George* 15046 (PERTH 00290858); N side of Mt Manypeaks, 40 km E of Albany, 12 Dec. 1986, *G.J. Keighery* 9021 (PERTH 00855170); Wright Rd, 1 km N of Brockman Highway, c. 15 km E of Bussell Highway, 34°09'S, 115°14'E, 11 Dec. 1985, *S.D. Hopper* 4745 (PERTH 00907561); Muirs Highway, 0.8 km W of Thomsons Rd turnoff, c. 50 km ESE of Manjimup, 34°27'S, 116°38'E, 13 Dec. 1985, *S.D. Hopper* 4763 (PERTH 00909114); Chesapeake Rd, 1 km E of Shannon River Bridge, c. 35 km NW of Walpole, 34°51'S, 116°23'E, 8 Dec. 1987, *S.D. Hopper* 6326 (PERTH 01191934); off Muir Highway, N side, c. 400 m W from Thompson Rd, 4 Dec. 1990, *W. Jackson* BJ192 (PERTH 01700006); Dinninup, E of Boyup Brook, 18 Nov. 1970, *C. Sumner* s.n. (PERTH 00335932).

Distribution and habitat. Ranges from the vicinity of Perth south to Augusta and eastwards to Manypeaks. Occurs in winter-wet swamps or adjacent to creeks at the northern end of its range, but is widespread in most habitats at the southern end. These include coastal heath, *Banksia* woodland, paperbark (*Melaleuca*) swamps, granite outcrop scrub, Jarrah/Marri forest, and Karri forest. Soils vary from sands to lateritic loams. (Figure 27D)

Flowering period. November to January. Flowers earlier near Perth than in southern localities.

Etymology. Named from the Latin *serotinus* (late-coming), alluding to the late flowering season of the species.

Notes. *Caladenia serotina* is a sporadically distributed but locally common species that may grow with or adjacent to earlier-flowering members of the *C. longicauda* complex including *C. longicauda*, *C. christineae* and *C. harringtoniae*. The only related species with which *C. serotina* grows, and which is similarly late-flowering, is *C. pholcoidea*. This differs in its much smaller labellum and its longer narrower pale yellow-coloured petals and sepals. *C. serotina* tends to flower in greater profusion after fire. It hybridizes occasionally with *C. radiata* and with *C. corynephora* to produce the hybrid described herein as *C. x aestantha*.

***Caladenia speciosa* Hopper & A.P. Br., sp. nov.**

A speciebus aliis *Caladenia longicauda* Lindl. affinis floribus albis plerumque suffusionibus dilute roseis, lamina magna anguste ovata vel ellipsoidea labelli, et fimbria marginali robusta saepe bifurcata ad 7–15 mm longa differt.

Typus: on the south-east side of the Bunbury By-Pass road, 1.8 km past the South Western Highway turnoff, travelling south, 33°22'S, 115°40'E, Western Australia, 9 September 1985, *S.D. Hopper* 4506 (*holo:* PERTH 01707019; *iso:* AD!, CBG!, K!, MEL!, NSW!, PERTH 02416353).

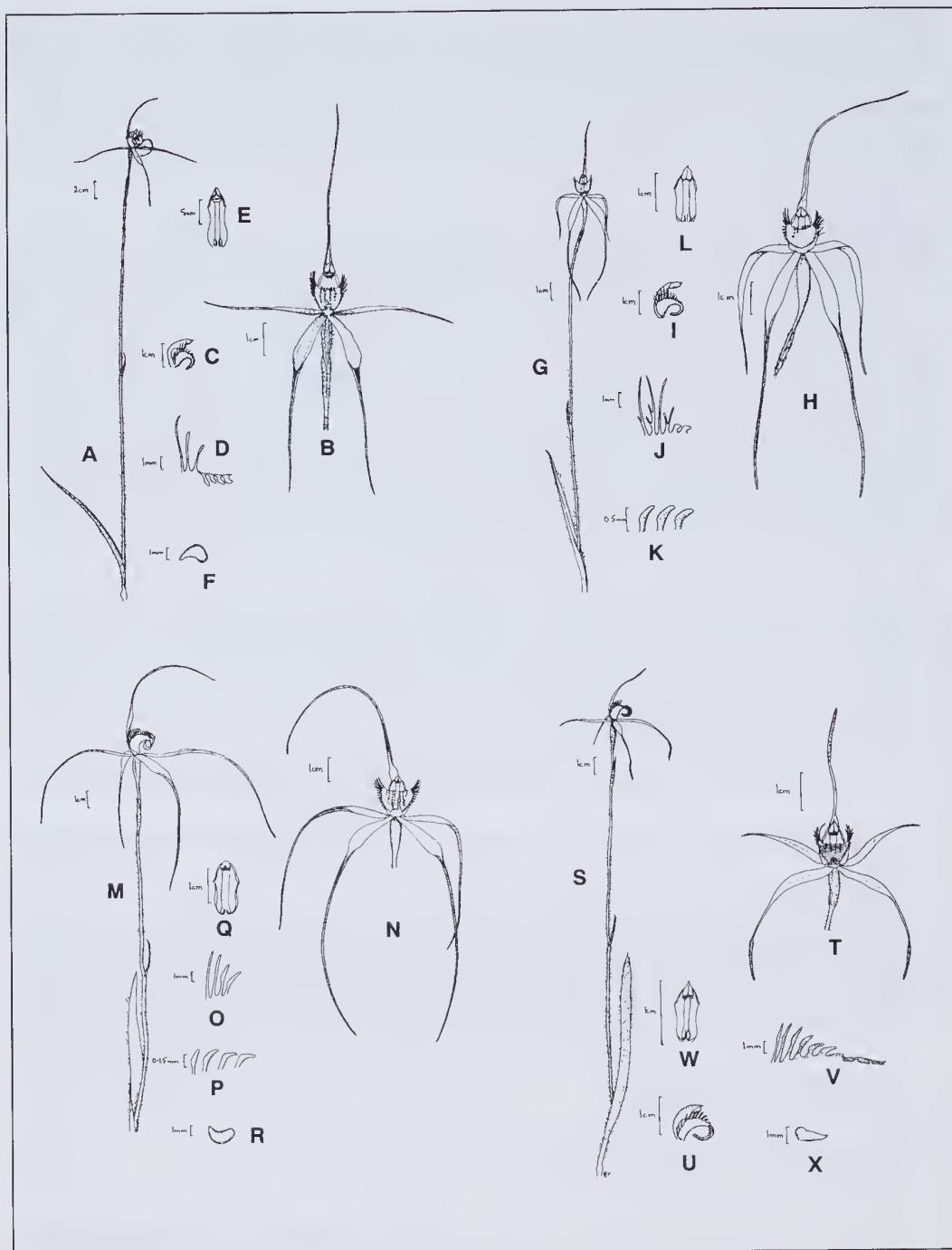


Figure 28. A–F. *Caladenia serotina* from the Lake Muir area, S.D. Hopper 4763. A – plant; B – flower from front; C – labellum and column from side; D – labellum fringe; E – column from front; F – pollinia. G–L. *C. speciosa* from the Bunbury area, S.D. Hopper 4511. G – plant; H – flower from front; I – labellum and column from side; J – labellum fringe; K – calli; L – column from front. M–R. *C. splendens* from the Gingin area, S.D. Hopper 6722. M – plant; N – flower from front; O – labellum fringe; P – calli; Q – column from front; R – pollinia. S–X. *C. viridescens* from Dunsborough, S.D. Hopper 4515. S – plant; T – flower from front; U – labellum and column from side; V – labellum fringe; W – column from front; X – pollinia. Drawn by S.J. Patrick.

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 85 (1992) and rev. 2nd edn with suppl., p. 85 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 15–25 cm x 5–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 35–60 cm tall. *Flowers* 1–3(4), c. 10–15 cm across, white often with pink suffusions, and with maroon markings on calli and pale maroon to pink lines on the back of petals and sepals; floral odour strongly sweet. *Sepals and petals* stiffly held with a lax apex, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect to curving forward near apex, 8–13 cm x 2.5–4 mm. *Lateral sepals* spreading, then obliquely downcurved with a vertical apex, 8–15 cm x 5–9 mm. *Petals* horizontal basally, then downcurved with a vertical apex, 6.5–10.5 cm x 3–6 mm. *Labellum* obscurely 3-lobed, white often with pink suffusions and basal lamina sometimes with pale maroon radiating stripes, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate in outline when flattened, 20–30 x 8–16 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely to vertically ascending calli; lateral lobes erect with entire margins within 5 mm of the claw, becoming fimbriate with slender acuminate narrowly fusiform sometimes bifurcate pale white to pink calli to 15 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows (sometimes towards apex in 2 rows, or irregularly aggregated) extending at least 9/10 the length of the labellum, white or pale pink, becoming white towards labellum apex, golf stick-shaped, the longest c. 2.5 mm tall, decrescent towards apex and becoming sessile. *Column* 15–23 x 7–12 mm, winged, greenish yellow with maroon blotches and suffusions. *Anther* c. 2.5–4 x 2.5–4 mm, maroon with yellowish suffusions. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 2.5–5 mm wide, yellow-green. *Capsule* not seen. (Figure 28G–L)

Selected specimens examined. WESTERN AUSTRALIA: 1 km SW of Capel, 21 Sep. 1988, G.J. Keighery 10473 (PERTH 01123335); Dorsett Rd, 0.4 km N from the intersection with Coronation Rd, c. 10 km W of Waroona, 32°51'S, 115°50'E, 17 Sep. 1985, S.D. Hopper 4606 (CBG, AD, PERTH 01200917); on Nicholson Rd, 0.3 km S of Johnson Rd, 6 km W of Yarloop, 32°57'S, 115°51'E, 17 Sep. 1985, S.D. Hopper 4608 (PERTH 01200933); Bunbury By-Pass Rd, 1.8 km past South West Highway turnoff, 33°22'S, 115°40'E, 22 Sep. 1985, S.D. Hopper 4640 (CBG, AD, K, MELB, PERTH 01198246); Bussell Highway, 5.5 km S of the Bunbury By-Pass, 33°24'S, 115°38'E, 22 Sep. 1985, S.D. Hopper 4647 (CBG, AD, K, PERTH 01198262); junction of Wellington and Wellesley Rds, c. 8 km NNW of Brunswick Junction, 33°11'S, 115°41'E, 16 Sep. 1987, S.D. Hopper 6052 (AD, CBG, PERTH 01198297); Hopelands Rd on the SE corner of Hopelands farm, 32°29'S, 115°50'E, 25 Sep. 90, S.D. Hopper 7850 (PERTH 1829963).

Distribution and habitat. Confined to the Swan Coastal Plain from near Mundijong south to Boyanup. Grows in deep Bassendean and Karakatta sands in banksia woodland with scattered Jarrah, or in Tuart woodland. Flowers best after fire. (Figure 29A)

Flowering period. September to October.

Etymology. Named from the Latin *speciosus* (showy, splendid), alluding to large flowers of the species with their striking often bifurcate labellum fringe.

Notes. *Caladenia speciosa* is a common but geographically restricted species (Priority Four) whose habitat is increasingly under threat as land use intensifies on the southern Swan Coastal Plain. It appears

to replace *C. longicauda* in this region. These two species are readily distinguished, *C. speciosa* having pinkish flowers with a very robust labellum and prominent sometimes bifurcated fringe. *C. splendens* attains the size of *C. speciosa*, but differs in its white colouration, shorter more ovate labellum and shorter simple labellum fringe. *C. speciosa* grows with several species of the *C. huegelii* complex, occasionally hybridizing with *C. huegelii*, *C. georgei* and *C. paludosa*.

The northernmost population of *Caladenia speciosa* near Mundijong tends to have a smaller labellum than southern populations, and warrants further taxonomic research. Near Manjimup occur some other anomalous populations, which resemble *C. speciosa* in having pale pink floral colouration and long sometimes bifurcate calli on the labellum margin, but differ in their larger flowers, later flowering period and occurrence in winter-wet flats. Further research on these populations is needed.

Caladenia splendens* Hopper & A.P. Br., *sp. nov.

A speciebus *Caladenia longicauda* Lindl. floribus magnis labello amplissimo et segmentis fimbriae labelli robustis ad 5–14 mm longis differt.

Typus: foot of Gingin scarp on Gingin Business Loop, c. 0.2 km north-east of Brand Highway turnoff, c. 5 km south of Gingin, 31°24'S, 115°54'E, Western Australia, 16 September 1986, *S.D. Hopper* 5480 (*holo*: PERTH 01706993; *iso*: AD!, CBG!, K!).

Illustrations. W. Nicholls, Orchids of Australia, plate 261, [as *Caladenia patersonii* var. *longicauda*] (1969); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 84 (1992) and rev. 2nd edn with suppl., p. 84 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 15–30 cm x 8–15 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–80 cm tall. *Flowers* 1–3(4), c. 10–22 cm across, white to creamy-yellow except for maroon markings on calli and pale maroon to pink lines on the back of petals and sepals; floral odour strongly sweet. *Sepals and petals* stiffly held to lax, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect to curving forward near apex, 9.5–16.5 cm x 3–11 mm. *Lateral sepals* spreading, obliquely downcurved or vertically hanging, 10.5–19 cm x 8–11 mm. *Petals* horizontal basally, then somewhat to prominently downcurved or vertically hanging, 8.5–13.5 cm x 4–6 mm. *Labellum* obscurely 3-lobed, uniformly coloured except basal part of lamina sometimes with pale maroon radiating stripes, stiffly articulate on a claw c. 2–3 mm wide; lamina narrowly cordate to cordate in outline when flattened, 30–35 x 15–22 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved; lateral lobes erect with entire margins within 7–10 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform pale to rich maroon white-tipped calli to 14 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows (rarely 8 near apex) extending 3/4 or more the length of the labellum, pale to dark maroon, golf stick-shaped, the longest c. 3 mm tall, decrescent towards apex and becoming sessile. *Column* 18–24 x 10–13 mm, winged, greenish yellow with maroon blotches and suffusions. *Anther* c. 4–5 x 4–5 mm, maroon with yellowish suffusions. *Pollinia* c. 5 mm long, yellow. *Stigma* c. 5 mm wide, yellow-green. *Capsule* not seen. (Figure 28M–R)

Selected specimens examined. WESTERN AUSTRALIA: Dardanup, 1968, *I.R. Beltran* s.n. (PERTH 00911712); 9.8 km E of Mogumber on road to New Norcia, 31°02'S, 116°03'E, 17 Sep. 1983,

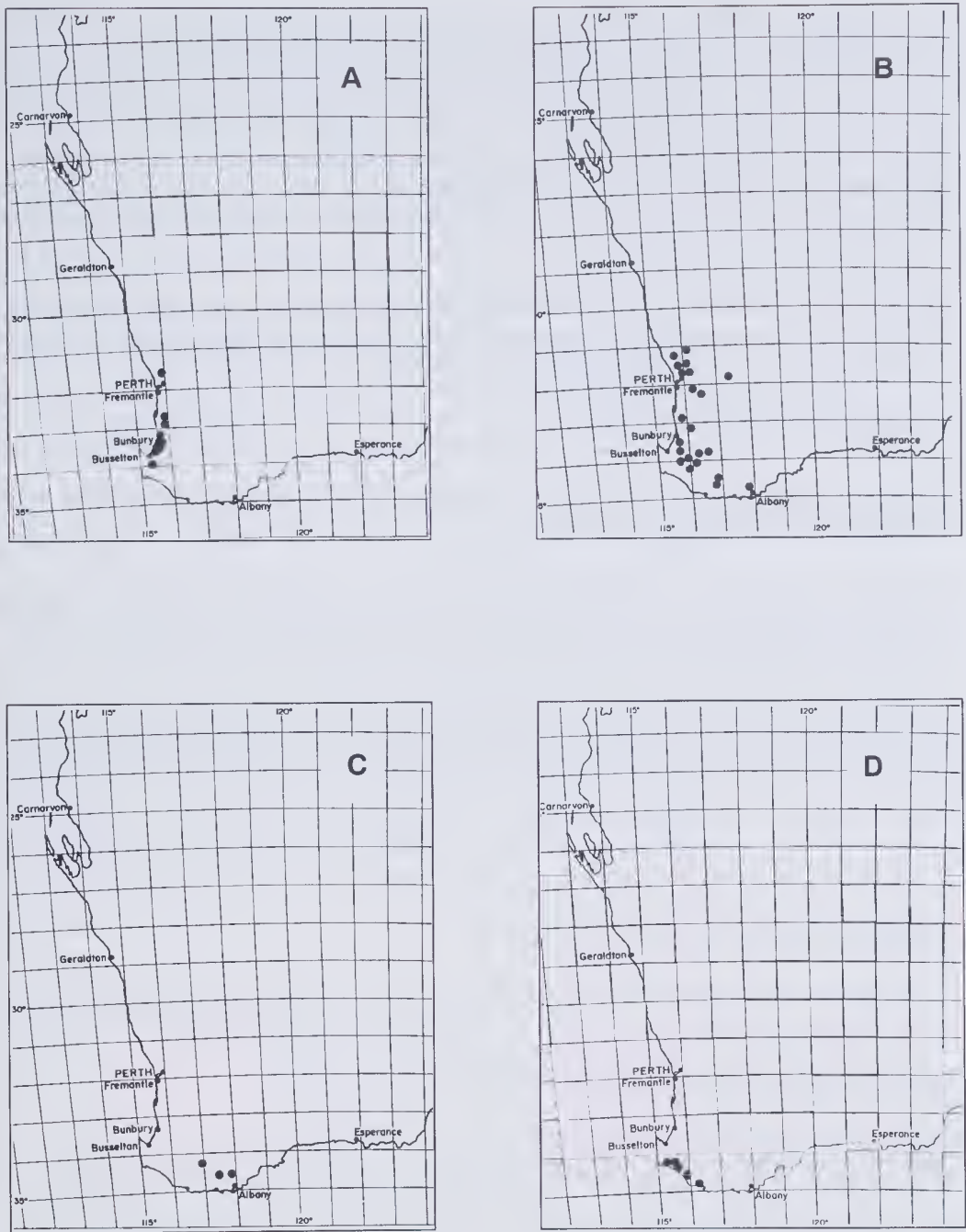


Figure 29. Distribution maps. A – *Caladenia speciosa*; B – *C. splendens*; C – *C. starteorum*; D – *C. thincola*.

R.J. Cranfield 4122 (PERTH 00329843); Frankland River, 16 Sep. 1958, *L. Higgens s.n.a* (PERTH 00911747); Old Muirs Bridge, 0.6 km N of Muirs Highway, 10 km WNW of Rocky Gully, 34°29'S, 116°54'E, 8 Oct. 1983, *S.D. Hopper* 3524 (CBG, PERTH 00278998); 2.1 km SSW of Wannamal West Rd on edge of Gingin Scarp, 31°11'S, 115°52'E, 18 Sep. 1986, *S.D. Hopper* 5494 (AD, CBG, K, PERTH 00910198); on N face of S Qualen Rd Rock, c. 17.5 km E of Mt Dale, 32°09'S, 116°28'E, 11 Sep. 1987, *S.D. Hopper* 6028 (PERTH 01208829); Gingin Access Rd, 0.2 km E across the Railway line, at the foot of the scarp, c. 5 km S of Gingin, 31°23'S, 115°55'E, 20 Sep. 1988, *S.D. Hopper* 6722 (PERTH 01208845); Yarloop, Sep. 1941, *E. Scouter s.n.* (PERTH 00289981); 1.5 km N of Greenbushes, 21 Sep. 1980, *T.G. Wilson s.n.* (PERTH 00278564).

Distribution and habitat. Known from Wannamal and Julimar south throughout high rainfall Jarrah forest areas to Balingup, and south-eastwards to Frankland, always inhabiting seasonally waterlogged soils on rock outcrops, moist gullies and flats. (Figure 29B)

Flowering period. September to October.

Etymology. Named from the Latin *splendens* (shining, brilliant), alluding to the brilliant white colouration and splendid size of the species.

Notes. This is one of the largest-flowered members of the *Caladenia longicauda* complex found in Western Australia, surpassed in size only by *C. excelsa*. It is characterised by tall scapes, a very robust labellum with a long fringe (in most populations), and very long broad pendulous petals and sepals.

Due to its obvious relationships with members of the *Caladenia longicauda* complex we have found assigning rank to *C. splendens* a difficult task. Within its seasonally-waterlogged habitats, *C. splendens* is uniformly larger than *C. longicauda*, notably in labellum dimensions, lateral sepal width and scape height. At the drier margins of its wet habitat, *C. splendens* does hybridise with larger-flowered subspecies of *C. longicauda* in a narrow ecotone. However, small-flowered subspecies of *C. longicauda* (e.g. subspp. *albella* and *redacta*) grow sympatrically with *C. splendens* in wet soils and no hybrids have been recorded. On balance, we consider specific rank is appropriate for *C. splendens*.

Caladenia starteorum Hopper & A.P. Br., *sp. nov.*

A speciebus aliis *Caladenia huegelli* H.G. Reich affinibus colore florum atro vel dilute roseo, petalis sepalisque ad basin crassiore ferentibus apicibus pendulis, sepalis lateralibus 4–5 cm longis, 4–5 mm latis plerumque exstendentibus oblique deorsum tum verticalibus pendentibus clavibus exilibus filiformibus cinereo-roseis fascientibus differt.

Typus: c. 25 km north of the South Coast Highway on the east side of the Denmark–Mount Barker road, 34°45'S, 117°30'E, Western Australia, 4 October 1991, *J. Start s.n.* (*holo:* PERTH 01935143).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 99 (1992) and rev. 2nd edn with suppl., p. 99 (1998).

Plant solitary or in loose colonies. **Leaf** erect, linear, 10–20 cm x 7–10 mm, pale green, basal third usually irregularly blotched with red-purple. **Scape** 20–60 cm tall. **Flowers** 1 or 2, c. 6–9 cm across, predominantly dark pink with white markings; floral odour unknown. **Sepals and petals** stiffly held, linear-lanceolate in basal 1/3–1/2, then abruptly narrowing to a long-acuminate apex; osmophore

tumescent, 10–20 mm long on sepals, absent from petals, greyish-pink to light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4–5 cm x 2–3 mm. *Lateral sepals* spreading to obliquely downcurved, 4–5.5 cm x 4–6 mm. *Petals* spreading to obliquely downcurved, 3–3.5 cm x 3–4 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, basal half of lamina white with pale pink radiating stripes, distal half uniformly dark pink with a recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate in outline when flattened, 19–25 x 10–12 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by obliquely ascending calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with slender rarely clubbed narrowly fusiform dark pink white-tipped calli to 5 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, dark pink (paler proximally), sometimes white at base, golfstick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 17–20 x 7–10 mm, moderately winged, creamy yellow with green and pink blotches. *Anther* c. 3 x 3 mm, pink and greenish yellow. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 4 mm wide, pinkish. *Capsule* not seen.

Selected specimen examined. WESTERN AUSTRALIA: 10 km E of Mount Barker on Porongurups Rd at the junction of Watermans Rd, 34°39'S, 117°46'E, 7 Oct. 90, S.D. Hopper 7895 (PERTH 01828940).

Distribution and habitat. Confined to a small range from the north side of the Porongurups west to Lake Muir. Flowers best after fire. It grows near the Porongurups in damp to water-logged grey clay-loam with occasional outcrops of sandstone in Swamp Yate, Jarrah and Marri low woodland over open low scrub and herbs, with *Anigozanthos bicolor* subsp. *decrescens*, *Caladenia longicauda* subsp. *redacta* and *Tribonanthes* spp. To the south-west of Mount Barker, *C. starteorum* grows on winter-wet flats and drainage lines in low scrub and herbfields with scattered *Eucalyptus patens* and paperbark melaleucas. Near Lake Muir it also grows on wet flats. Flowers best after fire. (Figure 29C)

Flowering period. Late September to October.

Etymology. Named after the Start family, including John (1919–) and Helen (1921–), retired at Roleystone, and their sons Tony (1946–, Principal Research Scientist, CALM) and Joff (1948–, businessman and farmer, Albany). All members of the family have been exceptionally helpful in bringing to our attention interesting orchids. Joff was involved in the early collection of specimens of *Caladenia starteorum*, and believed it was a new species.

Notes. A rare and recently discovered species (Priority Two) whose conservation status needs further study. It is most similar to *Caladenia winfieldii*, differing in its larger column, the white (rather than pale pink) base of the labellum lamina, its shorter petals and its smaller lateral sepals with a shorter osmophore. *C. starteorum* also flowers earlier (September to October) than *C. winfieldii* (late October to November). It is somewhat similar to *C. harringtoniae*, but differs in its shorter sepals with an osmophore, its larger labellum with longer marginal calli, and its larger column. *C. starteorum* differs from *C. gardneri* in its darker pink colouration, its broader labellum, its longer and more slender clubs, its taller scapes and its more inland distribution in wetter soils.

The species was first collected (west of Mount Barker) in 1991. Two further populations were found in 1993 (Porongurups) and 1995 (Lake Muir). In all three cases, the species was found in recently burnt habitat. Visits to these sites in subsequent years have found the species in much reduced numbers.

Caladenia thinicola* Hopper & A.P. Br., *sp. nov.

A speciebus aliis affinis *Caladenia huegelii* H.G. Reichb. petalis sepalisque plerumque pallido-viridibus suffusis hebetibus pallido-marroninis, sepalis lateralibus clavis gracilibus pallido glandaceis 10–15 mm longis, et fimbria labelli segmentorum acutorum gracilium pallido-viridibus differt.

Typus: base of Yeagarup Dunes, 20 km south-west of Pemberton, 34°33'S, 115°52'E, Western Australia, 8 October 1984, *S.D. Hopper* 4265 (*holo*: PERTH 00255548).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, rev. 2nd edn with suppl., p. 425 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 13–26 cm x 6–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 45–50 cm tall. *Flowers* 1–3(4), c. 5–6 cm across, predominantly yellowish-green with variable suffusions, lines and spots of dull maroon; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/3–1/4, then abruptly narrowing to a long-acuminate apex; osmophore slightly to prominently tumescent, 10–15 mm long on sepals, absent from petals, light brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, c. 4 cm x 2 mm. *Lateral sepals* obliquely downcurved, c. 4 cm x 3 mm. *Petals* horizontal to obliquely downcurved, c. 3.5 cm x 2 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, yellowish-green to cream with dull maroon radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate to cordate in outline when flattened, 15–16 x 12–13 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender acuminate linear greenish yellow calli to 8 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 3/4 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 1.2 mm tall, decrescent towards apex and becoming sessile. *Column* 17–20 x 6 mm, broadly winged, yellowish green with maroon blotches. *Anther* c. 4 x 4 mm, yellowish green and dark maroon. *Pollinia* c. 4 mm long, yellow. *Stigma* c. 4 mm wide, dark yellowish brown. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: 3.3 km E of Gracetown on Gracetown Rd, 10 km NW of Margaret River, 33°51'S, 115°00'E, 9 Oct. 1984, *S.D. Hopper* 4291 (PERTH 00330809); Cape Naturaliste road, 3 km NW of Dunsborough, 33°36'S, 115°05'E, 25 Sep. 1985, *S.D. Hopper* 4651 (PERTH 01710524); 700 m W of Rocky Point, 300 m up from ocean, 33°33'S, 115°03'E, 22 Sep. 1986, *S.D. Hopper* 5515 (PERTH 00874078); S of Rocky Point, 33°34'S, 115°04'E, 22 Sep. 1986, *S.D. Hopper* 5520 (PERTH 00874108); Scott National Park, track to Twinhams Bend, 150 m S of crossing, 26 Sep. 1990, *C.J. Robinson* 195B (PERTH 01824074).

Distribution and habitat. Extreme south-west coast from Cape Naturaliste to the Warren River, south-west of Pemberton. Grows in deep sand in low coastal heath or woodland of Peppermint, Jarrah, Marri, Christmas Tree, *Hakea trifurcata*, *H. nitida* and *Darwinia citriodora*. (Figure 29D)

Flowering period. Late September to early November.

Etymology. Named from the Latin *thinium* (dune) and *-cola* (dweller, inhabitant), alluding to the habitat of the species.

Notes. A geographically restricted species (Priority Three). *Caladenia thinicola* is allied to *C. georgei* and to *C. huegelii*, from both of which it differs in its smaller flowers with petals and sepals that are consistently yellowish green and maroon, its labellum marginal calli yellowish green and its more southerly distribution and consistent confinement to coastal consolidated dunes. *C. thinicola* occasionally hybridises with *C. attingens*.

Caladenia uliginosa A.S. George, *Nuytsia* 5 (1): 56–57, t. 2 (1984). *Type*: 31 km north of Frankland, Western Australia, 3 October 1978, A.S. George 15250 (*holo*: PERTH 01490648; *iso*: AD!, CANB!, K!, MEL!, NSW!, PERTH 01490656).

Plant solitary or in loose to dense clumps. *Leaf* erect, linear, 5–20 cm x 6–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–35 cm tall. *Flowers* 1–4, c. 4–6 cm across, yellowish to greenish cream or white with occasional faint suffusions, lines and spots of dark maroon to pink, with or without a dark maroon labellum apex; floral odour strongly sweet or absent. *Sepals and petals* stiffly held, sometimes with a lax apex, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, sometimes with a decurved or recurved apex, 4.5–10 cm x 2–2.5 mm. *Lateral sepals* shortly horizontal or obliquely to steeply downcurved near base, with apex vertical, 5–10 cm x 3–5 mm. *Petals* shortly horizontal or obliquely downcurved near base, with apex vertical, 3.5–8 cm x 2.5–3 mm. *Labellum* obscurely 3-lobed, cream to white, suffused yellow or green with pink to maroon radiating stripes on lateral lobes adjacent to longest marginal calli, with or without a dark maroon apex, stiffly articulate on a claw c. 1.5 mm wide; lamina narrowly cordate in outline when flattened, 14–22 x 7–10 mm, basal half curving from erect to horizontal, then nearly horizontal before apical third sharply recurved, margins at widest point barely curved upwards and terminated by obliquely ascending margins and vertical calli; lateral lobes erect with entire margins within 3–4 mm of the claw, becoming fimbriate with slender acuminate to clubbed narrowly fusiform dark maroon to pink white-tipped calli to 2.5 mm long which are abruptly decrescent near midlobe; midlobe margins with short narrow forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 2/3 the length of the labellum, dark maroon, sometimes becoming white at tip, base white, golf stick-shaped, the longest c. 1 mm tall, decrescent towards apex and becoming sessile. *Column* 10–15 x 5–8 mm, winged, creamy yellow with pink blotches. *Anther* c. 2–2.5 x 2–2.5 mm, pale greenish yellow. *Pollinia* c. 2–2.5 mm long, yellow. *Stigma* c. 3 mm wide, yellow-green. *Capsule* not seen.

Distribution and habitat. Occurs in winter-wet sites and moist forest areas between Perth and Mount Barker.

Flowering period. Late September to November.

Notes. *Caladenia uliginosa* is a distinctive species that, although well known, was not named until 1984. It is a member of the *C. longicauda* complex, distinctive in its short calli on the labellum margins and the way its flowers are held when fresh. It is most similar to *C. christineae*, differing in its yellowish to greenish cream flowers, its usually longer petals and lateral sepals with a vertical apex, and its labellum which is erect to obliquely ascending in the basal half, and has a dark maroon apex in one subspecies.

Three subspecies are recognized. *Caladenia uliginosa* subsp. *candicans* and subsp. *uliginosa* are found in winter-wet sites in open Wandoo woodland and Jarrah/Marri forest along the western edge of the wheatbelt, and adjacent forest areas. *C. uliginosa* subsp. *patulens* occurs amongst dense shrubs in moist shaded sites in Jarrah/Marri forest between Harvey and Nannup.

Key to subspecies of *Caladenia uliginosa*

1. Labellum with a maroon apex subsp. **uliginosa**
- 1: Labellum with a white or yellowish-cream apex
 2. Petals and lateral sepals yellowish-cream, horizontal near base.
Labellum cream, suffused yellow on lateral lobes adjacent to
longest marginal calli subsp. **candicans**
 - 2: Petals and lateral sepals greenish-yellow, obliquely downcurved
near base. Labellum white, suffused green on lateral lobes adjacent
to longest marginal calli subsp. **patulens**

Caladenia uliginosa A.S. George subsp. **uliginosa**

Illustrations. D. Jones, Native Orchids of Australia, p. 134 line drawing, not photo on p. 135 (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 124 (1984), 2nd edn, p. 91 (1992) and rev. 2nd edn with suppl., p. 91 (1998).

Plant solitary or in loose to dense clumps. *Flowers* 1–4, predominantly greenish cream, with a dark maroon labellum apex; floral odour absent. *Lateral sepals and petals* steeply downcurved near base. *Labellum* cream, suffused green on lateral lobes adjacent to longest marginal calli. (Figure 30A–E)

Selected specimens examined. WESTERN AUSTRALIA: Towerlup Rd between Frankland and Kojonup, c. 26.9 km S of Jingalup, 34°12'S, 116°59'E, 17 Oct. 1985, A. Brown 260 (CBG, PERTH 00906506); 0.3 km W of Cordering adjacent to old Cordering Mill site, 33°30'S, 116°40'E, 20 Sep. 1984, E. Chapman s.n. (PERTH 00404268); near Dryandra, 29 Sep. 1971, A.S. George 11053 (PERTH 00251356); 12.5 km W of Frankland River, Muir Highway, 34°27'S, 116°46'E, 2 Nov. 1977, A.S. George 15023 (AD, CANB, K, MEL, NSW, PERTH 00251275); Woodanilling, turnoff from Albany Highway, 33°32'S, 117°05'E, 3 Oct. 1978, A.S. George 15263 (PERTH 00251739); 26 km ENE of Wilga Siding, 25 km NNE of Boyup Brook, 33°39'S, 116°30'E, 6 Oct. 1983, S.D. Hopper 3479 (AD, CBG, K, MEL, PERTH 00250856); 12 km NNE of Chowerup Mill, 18 km SSE of Kulikup Siding, 33°59'S, 116°48'E, 6 Oct. 1983, S.D. Hopper 3490 (PERTH 00250821); 8 km WSW of Kojonup, 0.5 km N of Farrar Siding on Kojonup–Boyup Brook road, 33°50'S, 117°05'E, 6 Oct. 1983, S.D. Hopper 3492 (CBG, PERTH 00250848).

Distribution and habitat. Found between the York area southwards to Manjimup and Rocky Gully in winter-wet flats, often in the presence of Wandoo, along the western edge of the wheatbelt, and adjacent forest areas. Flowering appears to be enhanced by summer fire. (Figure 31A)

Flowering period. September to November.

Notes. *Caladenia uliginosa* subsp. *uliginosa* is readily distinguished from the other subspecies by its maroon labellum apex. It grows with *C. uliginosa* subsp. *candicans* in the northern part of its range. *C. uliginosa* subsp. *uliginosa* crosses with *C. longicauda* to produce the hybrid *C. x exerta*. This hybrid is illustrated [as *C. uliginosa*] by Jones (1988: 135).

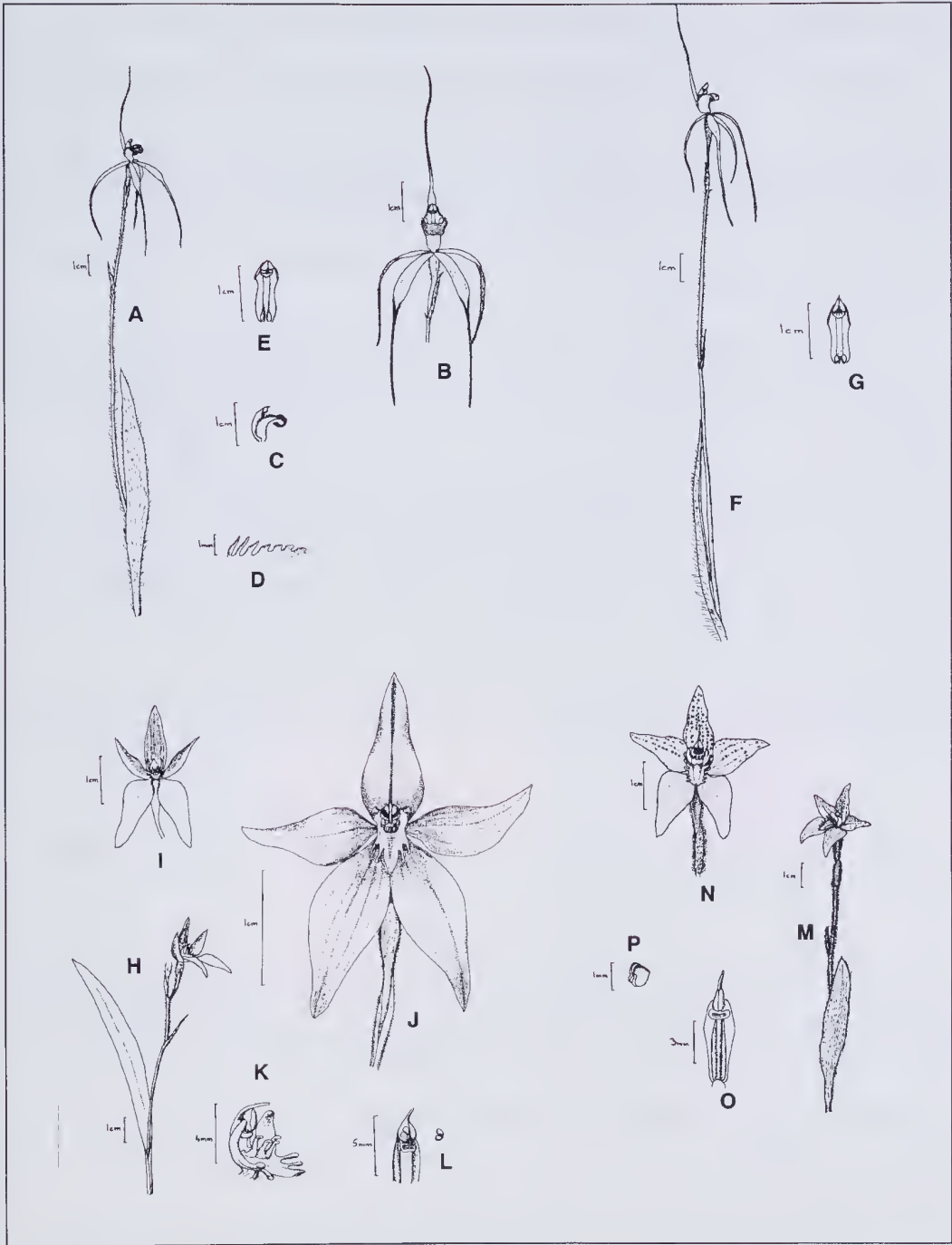


Figure 30. A-E. *Caladenia uliginosa* subsp. *uliginosa* from the Kojonup area, A.P. Brown 260. A – plant; B – flower from front; C – labellum and column from side; D – labellum fringe; E – column from front. F,G. *C. uliginosa* subsp. *candicans* from the Dale area, S.D. Hopper 5639. F – plant; G – column from front; H-L. *C. flava* subsp. *flava* from Wandering, A.P. Brown s.n. H – plant; I – flower from front; J – flower from front, enlarged view; K – labellum and column; L – column from front. M-P. *C. flava* subsp. *maculata* from the Kalbarri area, S.D. Hopper 6308. M – plant; N – flower from front; O – column from front; P – pollinia. Drawn by S.J. Patrick.

Caladenia uliginosa A.S. George subsp. **candicans** Hopper & A.P. Br., *subsp. nov.*

A subspecie typica floribus citrinis tepalis brevioribus, petalis brevioribus et lamina labelli omnino citrina differt.

Typus: Dale West Rd, c. 4.2 km east-north-east of Brookton Highway, 32°14'S, 116°29'E, Western Australia, 12 October 1986, *S.D. Hopper* 5639 (*holo:* PERTH 01708090; *iso:* AD!, CBG!, K!, MEL!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 89 (1992) and rev. 2nd edn with suppl., p. 89 (1998).

Plant solitary or in loose to dense clumps. *Flowers* 1–3, predominantly yellowish cream, without a dark maroon labellum apex; floral odour strongly sweet. *Lateral sepals and petals* horizontal near base. *Labellum* yellowish-cream, suffused yellow on lateral lobes adjacent to longest marginal calli. (Figure 30F,G)

Selected specimens examined. WESTERN AUSTRALIA: 26 km ENE of Wilga, 33°39'S, 116°30'E, 2 Oct. 1975, *E. Chapman s.n.* (PERTH 00251267); 4 miles [6 km] E of Williams, 21 Sep. 1957, *A.S. George s.n.* (PERTH 00252220); Highbury and Pindalup, Oct. 1924, *B.T. Goadby s.n.* (PERTH 00870404); Highbury, Oct. 1924, *B.T. Goadby s.n.* (PERTH 00309419); Dryandra State Forest, Narrogin Map 1:100,000, Grid Reference 003730, 16 Sep. 1987, *D.M. Rose* 245a (PERTH 01699423).

Distribution and habitat. Occurs in a narrow strip along the western edge of the wheatbelt between Kojonup and York. Grows under scattered Wandoo amongst dense sedges and annuals in low-lying clay flats. Soil is sandy-clay. (Figure 31B)

Flowering period. September to October.

Etymology. Named from the Latin *candicans* (becoming pure white), alluding to the creamy-white colouration of this subspecies.

Notes. A subspecies of restricted distribution between Kojonup and York. It and *Caladenia uliginosa* subsp. *uliginosa* rarely grow sympatrically, although their distributions overlap and both occur in large numbers in areas of favourable habitat. Flowers of subsp. *candicans* are yellowish-cream, lacking the maroon labellum apex of the typical subspecies. Subsp. *candicans* is similar to subsp. *patulens*, but differs in having yellowish-cream flowers and a more easterly distribution in Wandoo woodland flats.

Caladenia uliginosa subsp. *candicans* hybridizes freely with *C. longicauda*.

Caladenia uliginosa A.S. George subsp. **patulens** Hopper & A.P. Br., *subsp. nov.*

A subspeciebus aliis *Caladenia uliginosae* A.S. George floribus pallido-viridibus, petalis sepalisque longioribus minus rigide ferentibus, et apice labelli albido tenenti suffusiones pallido-virides gradatim recurvatas differt.

Typus: 400 m south-east from east end of CALM's Blackboy Picnic Ground, near Harvey, 33°05'S, 115°54'E, Western Australia, 25 September 1987, *S.D. Hopper* 6105 (*holo:* PERTH 01071130; *iso:* AD!, CBG!).

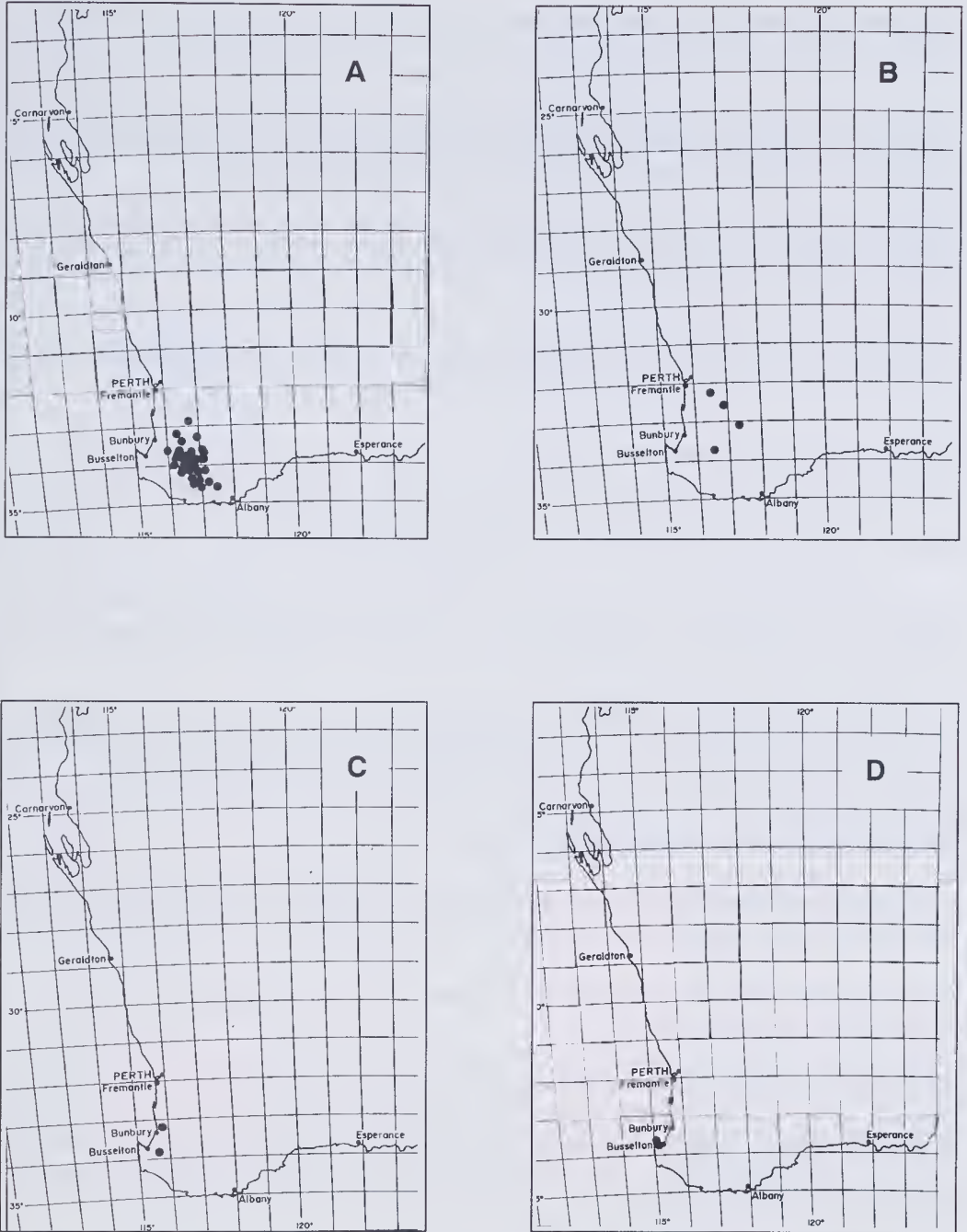


Figure 31. Distribution maps. A – *Caladenia uliginosa* subsp. *uliginosa*; B – *C. uliginosa* subsp. *candicans*; C – *C. uliginosa* subsp. *patulens*; D – *C. viridescens*.

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 90 (1992) and rev. 2nd edn with suppl., p. 90 (1998).

Plant solitary. *Flowers* 1–3, predominantly greenish cream, without a dark maroon labellum apex; floral odour strongly sweet. *Lateral sepals and petals* obliquely downcurved near base. *Labellum* basally white, suffused green on lateral lobes adjacent to longest marginal calli.

Selected specimens examined. WESTERN AUSTRALIA: junction of Honeymoon Rd and South West Highway, c. 20 km S of Waroona (c. 5 km N of Harvey), 33°02'S, 115°55'E, 21 Sep. 1984, A. Brown 123 (K, PERTH 00252239).

Distribution and habitat. Known from just two small populations near Harvey and Nannup where it grows amongst dense shrubs in Jarrah/Marri forest. Soil is clay-loam. (Figure 31C)

Flowering period. Late September to October.

Etymology. Named from the Latin *patulus* (spread, outspread), alluding to the more spreading petals and sepals of this subspecies compared to the nominate subspecies.

Notes. This is a rare subspecies of very restricted occurrence (Priority One), regarded as poorly known and in urgent need of further survey (Hopper *et al.* 1990). It has only been recorded flowering in the first spring following summer wildfires.

Caladenia uliginosa subsp. *patulens* differs notably from the other two subspecies in its predominantly white labellum, the intermediate downcurved angle of the basal lamina of its lateral sepals and petals, and its more westerly occurrence in moist soils in Jarrah/Marri forest on the Darling Scarp.

***Caladenia viridescens* Hopper & A.P. Br., sp. nov.**

A speciebus affinibus *Caladenia huegelii* H.G. Reichb. petalis sepalisque pallido-viridibus rigide tenentibus et labello angusto differt.

Typus: Cape Naturaliste, Western Australia, 26 September 1985, S.D. Hopper 4657 (*holo:* PERTH 01099620; *iso:* AD!, CBG!, MEL!).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora plate 53 [as *Caladenia* sp. (Dunsborough) S.D. Hopper 5520b 'Dunsborough Spider Orchid'] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 103 (1992) and rev. 2nd edn with suppl., p. 103 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 116 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 15–20 cm x 5–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 25–40 cm tall. *Flowers* 1–3(4), c. 5–7 cm across, predominantly pale greenish yellow with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a long-acuminate apex; osmophore prominently tumescent, 5–14 mm long on sepals, absent from petals, light to dark brown, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 4–5 cm x 2.5–3 mm. *Lateral sepals* horizontal obliquely

spreading with downcurved apex, 4.5–5 cm x 3–7 mm. *Petals* horizontal to obliquely descending, 3.5–4 cm x 2.5–3 mm. *Labellum* obscurely 3-lobed, prominently 2-coloured, greenish-yellow to pink with dull maroon to red radiating stripes, terminating in a shiny uniformly dark maroon recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina narrowly cordate in outline when flattened, 17–22 x 10–14 mm, basal third curving from erect to oblique, middle third curving to horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending calli; lateral lobes erect with entire margins near the claw, becoming fimbriate with slender clubbed linear dark maroon (sometimes white-tipped) calli to 4 mm long which are abruptly decrescent near midlobe; midlobe margins with short broad slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, dark maroon, sometimes white at base, golf stick-shaped, the longest c. 1.5 mm tall, decrescent towards apex and becoming sessile. *Column* 15–18 x 6–9 mm, broadly winged, creamy to greenish yellow with red-pink blotches. *Anther* c. 2.5 x 2.5 mm, dark maroon. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 2.5 mm wide, dark yellow-green. *Capsule* not seen. (Figure 28S–X)

Selected specimens examined. WESTERN AUSTRALIA: Cape Naturaliste, 9 Sep. 1985, S.D. Hopper 4515 (PERTH 01198238); Cape Naturaliste, 25 Sep. 1985, S.D. Hopper 4650 (PERTH 01198211).

Distribution and habitat. Confined to a small area on Cape Naturaliste over a 10 km range, favouring Marri, Jarrah and Peppermint woodlands on lateritic loam, sand or sandy clay. (Figure 31D)

Flowering period. September to October.

Etymology. Named from the Latin *viridi-* (green), and the suffix *-escens* (becoming), alluding to the pale greenish-yellow colour of the sepals, petals and rear labellum lamina.

Notes. A rare species of very restricted distribution, currently declared as Rare Flora (Hopper *et al.* 1990, Brown *et al.* 1998). *Caladenia viridescens* is allied to *C. paludosa*, from which it differs in its somewhat smaller flowers, its paler petals and sepals, its lateral sepals often splayed out horizontally, and its narrower less cordate labellum. The two species grow together near Dunsborough. *C. brownii* also grows nearby and has greenish flowers with dark maroon markings, but flowers later (October to December) and is readily distinguished by its clubbed petals.

Caladenia winfieldii* Hopper & A.P. Br., *sp. nov.

A speciebus affinis *Caladenia huegellii* H.G.Reichb. floribus prominente roseis et petalis sepalisque rigide tenentibus prope basim apicibus pendulis deficientibus clavas distinctas differt.

Typus: near Manjimup, Western Australia, 29 October 1987, S.D. Hopper 6305 (*holo:* PERTH 01068849; *iso:* AD!, CBG!, MEL!, PERTH 01067389).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 93 (1992) and rev. 2nd edn with suppl., p. 93 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 133 (1998).

Plant solitary, rarely up to three scapes. *Leaf* erect, linear, 10–15 cm x 6–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 30–60 cm tall. *Flowers* 1 or 2, c. 5–10 cm across, pale to dark pink; floral faint, sweet. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/

5–1/3 then abruptly narrowing to a long-acuminate apex; osmophore slightly tumescent, 10–30 mm long in sepals, absent from petals, fawn, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and slightly incurved, 3.5–7 cm x 2–4 mm. *Lateral sepals* spreading then obliquely downcurved, 3.5–7.5 cm x 4–7 mm. *Petals* spreading horizontally then obliquely downcurved, 3–5.5 cm x 3–5 mm. *Labellum* obscurely 3-lobed, 2-coloured, basal half of lamina pale pink with slightly darker radiating stripes, distal half uniformly dark pink with a recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina linear-cordate in outline when flattened, 15–23 x 10–11 mm, basal third curving from erect to horizontal, middle third nearly horizontal, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli; lateral lobes obliquely ascending with entire margins near the claw, becoming fimbriate with slender clubbed narrowly fusiform dark to pale pink calli to 6 mm long which are abruptly decrescent near midlobe; midlobe margins with short slender forward-facing obtuse calli decrescent towards the apex. *Lamina calli* in 4 rows extending at least 4/5 the length of the labellum, dark pink (paler proximally), sometimes white at base, golf stick-shaped, the longest c. 2 mm tall, decrescent towards apex and becoming sessile. *Column* 14–18 x 6–8 mm, broadly winged, pink with darker blotches and pale yellow suffusions. *Anther* c. 3 x 3 mm, pink and greenish yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3 mm wide, pinkish. *Capsule* not seen. (Figure 32)

Distribution and habitat. Confined to a small area near the Tone River where it grows along the floor of subdued drainage lines and flats beneath open low woodland of Flooded Gum, *Melaleuca preissiana*, *Xanthorrhoea preissii*, *Acacia saligna* and *Banksia littoralis* in dark grey sandy loam rich in humus. (Figure 33A)

Flowering period. Late October to November.

Etymology. Named after the late Mr Harry Winfield (1924–1993), field officer with the Western Australian Forests Department for 42 years who knew of and cultivated the species since the late 1970s, and who first directed us to wild populations in 1987. Harry had a life-long interest in the orchids of the south-west, and was a keen photographer and enthusiast.

Notes. A rare species of very restricted distribution (Declared Rare), known only from the type collection, currently on the schedule of Declared Threatened Flora. *Caladenia winfieldii* is similar to *C. starteorum*, differing in its shorter column, the pale pink (rather than white) base of its labellum lamina, its longer petals and its larger lateral sepals with a longer narrower osmophore.

Caladenia winfieldii is also similar to *C. harringtoniae*, with which it grows, but differs in its somewhat broader petals, its sepals with an osmophore, its longer labellum, its taller broader column, and uniformly pink colouration. *C. winfieldii* also resembles *C. gardneri* in its pink colouration, but is darker and has slender and tapering rather than swollen osmophores

Caladenia subgenus **Drakonorchis** Hopper & A.P. Br., *Lindleyana* 15 (2): 120–126 (2000). *Type:* *Caladenia barbarossa* H.G. Reichb., lectotype *fide* Hopper & Brown (2000: 124).

Drakonorchis Hopper & A.P. Br. *nom. inval.* in N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 189 (1992) and rev. 2nd edn with suppl., p. 189 (1998).

Petals held obliquely or vertically downwards, and backwards, 1–2.5 cm long. *Labellum* claw longer than 2 mm, with paired horn-like appendages; lamina hirsute on margins above, insectiform, lacking capitate calli except for three large basal ones known as shoulder calli.

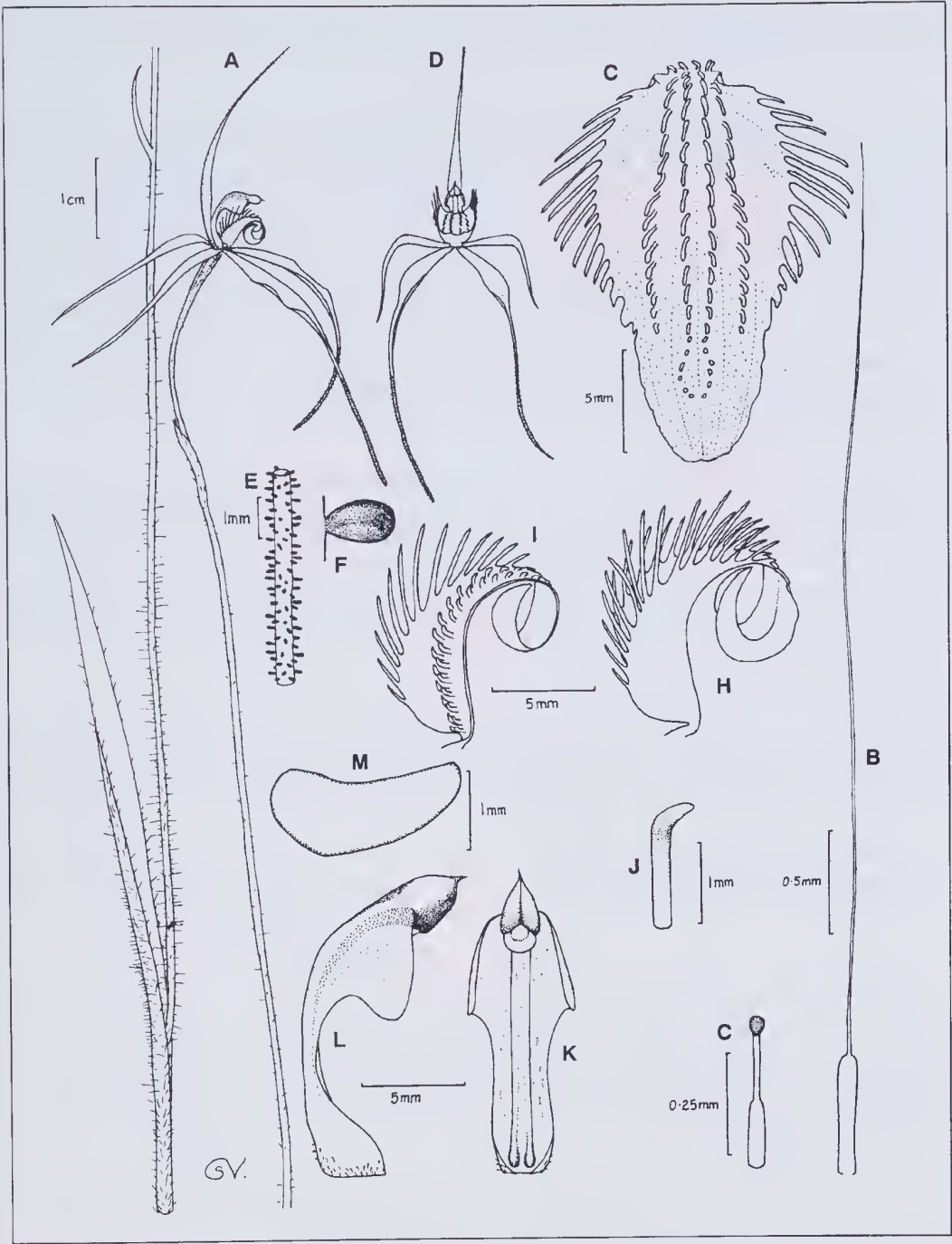


Figure 32. *Caladenia winfieldii* from south-west of Manjimup, S. van Leeuwen 326. A – plant; B – stem hair; C – leaf hair; D – flower from front; E – sepal tip; F – gland on sepal tip; G – labellum from above; H – labellum from side; I – labellum longitudinal section; J – calli; K – column from front; L – column from side; M – pollinia. Drawn by C. Vasilu.

Notes. *Caladenia* subgenus *Drakonorchis* has four species, three here described as new, all of which are endemic in south-western Australia. All are commonly referred to as dragon orchids.

James Drummond, in a letter to Hooker at Kew dated 14 October 1839, argued that the single dragon orchid then known to him was generically distinct from *Caladenia*, but his view did not prevail from the time Reichenbach described the species as *Caladenia barbarossa* in 1871. Initially, we were also of the view that the dragon orchids are removed from *Caladenia* due to a number of attributes, and proposed erecting the genus *Drakonorchis* to reflect this view (Hoffman & Brown 1992, 1998). The dragon orchids' floral features include a highly modified insectiform labellum lamina on an elongate hinged claw with two horn-like appendages. Calli are absent on the labellum lamina except for three large complex retrorse basal head-like structures, and the labellum lamina is covered with scattered tufts of elongate hairs rather than calli. This floral morphology is associated with pollination by the sexual deception of male thynnid wasps (Stoutamire 1983), and closely parallels that seen in *Drakaea* flowers. Many other species of *Caladenia* have similar pollinators, but they display far less floral modification towards insect mimicry than is seen in the dragon orchids.

However, recent DNA sequence studies of the *Caladenia* alliance in the Diurideae (Kores *et al.* unpublished) have established that the dragon orchids are deeply embedded within *Caladenia sens. lat.* This is supported by non-floral morphological evidence. For example, the dragon orchids have a sparsely hirsute leaf and scape, and petals and sepals are similar to those seen in species such as *C. roei*. Also, *C. barbarossa* is associated with the fungus *Sebacina vermifera* (M. Clements pers. comm.), the common endophyte of *Caladenia* species (Warcup 1971). Also Pridgeon (1993, 1994) found no unique anatomical features in the leaves of *C. barbarossa* in his study of a limited number of herbarium specimens of *Caladenia* and allied genera.

Hence, we no longer consider that the morphological differences between the dragon orchids and *Caladenia* are sufficient to warrant separate generic status. Rather, they have been placed as a distinct subgenus within *Caladenia* (Hopper & Brown 2000).

The dragon orchids have been considered for a long time to be monotypic, all belonging to a single variable species *Caladenia barbarossa*. However, over the past decade, it has become apparent that there are four species of *Caladenia* subgenus *Drakonorchis*, three of them described as new below.

As in *Drakaea* the labellum of a *Caladenia* subgenus *Drakonorchis* flower is recognizably insectiform and we have used descriptive terms applied to insects to describe the lamina. Thus, the apical area of the lamina is referred to as the 'tail', the main body the 'abdomen', and the enlarged calli near the claw collectively as the 'head' subtended by a narrower 'neck' which arises from the 'shoulders', each of the latter having a prominent callus. The 'claw connection' refers to that part of the labellum lamina linking the main insectiform body to the apical hinge of the claw where the two horn-like appendages are attached.

Rare hybrids between *Caladenia drakeoides* and *C. exilis* subsp. *exilis*, and between *C. barbarossa* and *C. longicauda* (Heberle 1982; Hoffman & Brown 1984) have been found, and are named as *Caladenia x ornata* and *Caladenia x enigma* respectively in this paper.

Caladenia barbarella Hopper & A.P. Br., *sp. nov.*

Drakonorchis barbarella Hopper & A.P. Br. *nom. inval.* in N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 191 (1992) and rev. 2nd edn. with suppl., p. 191 (1998), A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 138 (1998).

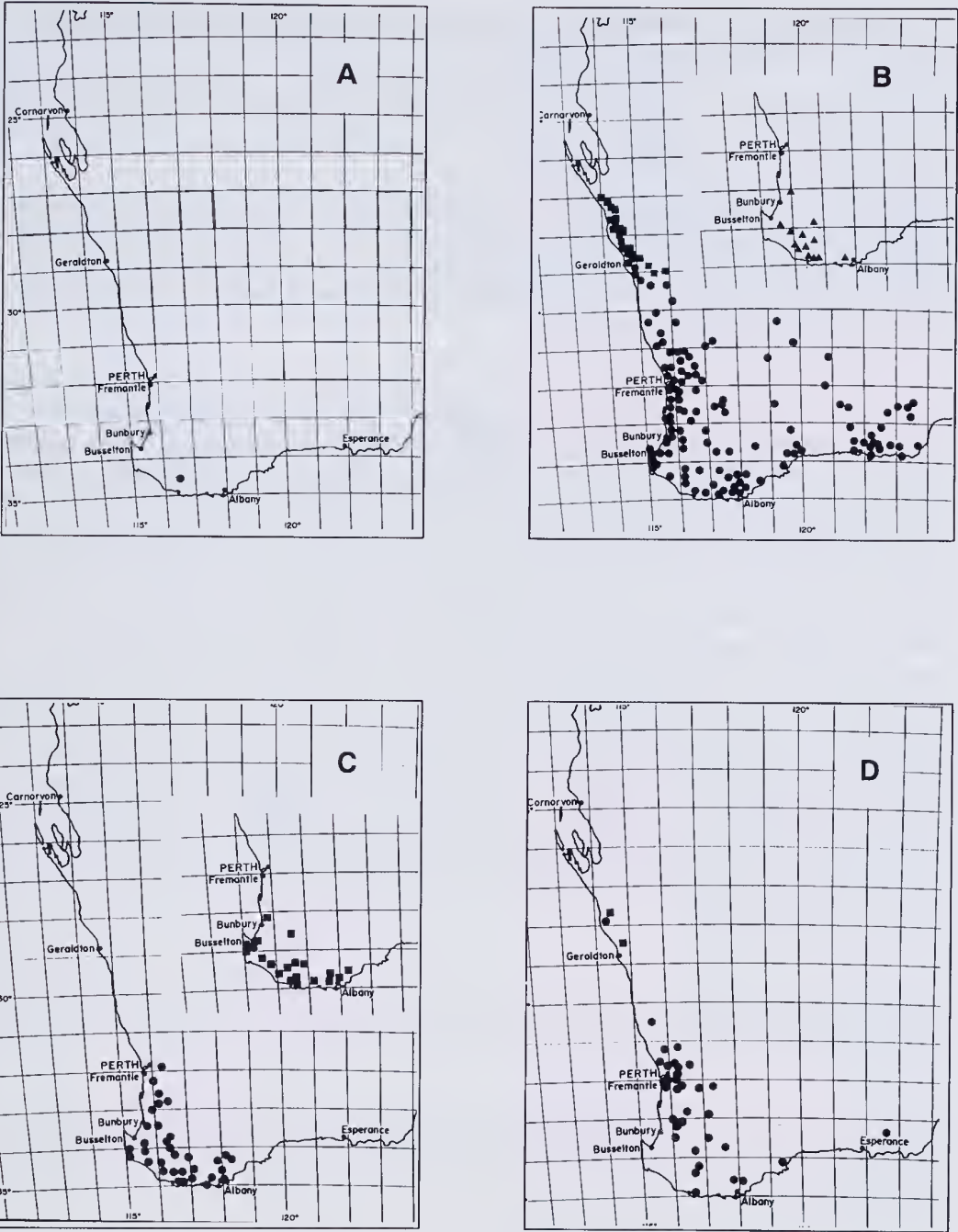


Figure 33. Distribution maps. A – *Caladenia winfieldii*; B – *C. flava* subsp. *flava* ●, *C. flava* subsp. *maculata* ■ and *C. flava* subsp. *sylvestris* ▲; C – *C. nana* subsp. *nana* ● and *C. nana* subsp. *unita* ■; D – *C. reptans* subsp. *reptans* ● and *C. reptans* subsp. *impensa* ■.

A Caladenia barbarossa H.G.Reichb. floribus parvioribus minus hirsutis glandulibus epiomidiis parvioribus brevioribus in lamina labelli differt.

Typus: Cooloomia Nature Reserve, Western Australia, 22 August 1983, *S.D. Hopper* 3272. (*holo:* PERTH 00255343; *iso:* AD, CBG, K, MEL).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 58 [as *Caladenia* sp. (Murchison)] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 191 (1992) and rev. 2nd edn with suppl., p. 191 [as *Drakonorchis barbarella*] (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 138 [as *Drakonorchis barbarella*] (1998).

Plant solitary or in small clumps. *Leaf* more or less prostrate, linear, 2–8 cm x 3–6 mm, pale green. *Scape* 8–25 cm tall. *Flowers* solitary, c. 2 cm across, cream to greenish-yellow with maroon stripes and markings; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate, cream to greenish yellow with a thick medial linear maroon stripe, shortly constricted at apex, glabrous, lacking a tumescent osmophore. *Dorsal sepal* obliquely ascending backwards, 1–1.5 cm x 1.5–2 mm. *Lateral sepals* thrust downwards somewhat obliquely off vertical away from ovary, 1–1.5 cm x 1.5–2.5 mm, basal 2/3 narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to the slightly incurved apex. *Petals* c. 1 cm x 1–1.5 mm, thrust downwards somewhat obliquely off vertical away from ovary with apices slightly incurved. *Labellum* cream to greenish-yellow with dark maroon hairs and calli, stiffly articulate on a claw c. 2 mm x 1.5–2 mm held obliquely upwards; claw connection c. 1 x 1.5 mm; abdomen vertical to recurved, held above the top of the ovary, ovate with rounded entire hirsute margins in outline when flattened, 5–6 x 3–4 mm, 1-lobed, obliquely descending outwards then recurved in the apical 2/3, terminating in an undifferentiated shallowly channelled tail, margins at widest point vertical and flat, with 2 longitudinal rows of simple hairs converging near the tail. *Shoulder calli* robust, capitate, c. 1 mm tall; head oblong, 1.5–2 mm wide, dark maroon in colour, with a lateral cranial depression and two lateral anterior slight swellings (not antenna-like as in *Caladenia barbarossa*). *Column* 8–10 x 3–5 mm, broadly winged, translucent greenish-cream with maroon markings. *Anther* c. 1.5–2.0 x 1.5–2.0 mm, greenish-yellow. *Pollinia* c. 1.5–2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 34A–F).

Selected specimens examined. WESTERN AUSTRALIA: N of Murchison River, 24 Aug. 1969, A.S. George 9529 (K, MEL, PERTH 00255335); WSW of Nerren Nerren Homestead, 27°15'S, 114°14'E, 22 Aug. 1983, *S.D. Hopper* 3270 (PERTH 00255327).

Distribution and habitat. Confined to a small areas near the lower Murchison River, where it grows in winter-wet depressions in undulating plain under low heath of Broom Bush (*Melaleuca uncinata*), or alongside creeklines beneath *M. uncinata* and *Acacia* scrub and thickets. Soils are pale brown sandy loams. (Figure 35A)

Flowering period. Late August to September

Etymology. Named from the Latin *barba* (beard) and the diminutive suffix *-ella* (small), alluding to the smaller flower size compared with that of *Caladenia barbarossa*. Barbarella of the 1960s French comic strip was also a fictitious lady from outer space who used sexual deception on males to gain power over them (Forest 1984). The epithet is therefore appropriately derived from this context as well, given that the species is pollinated by sexual deception of male thynnid wasps.

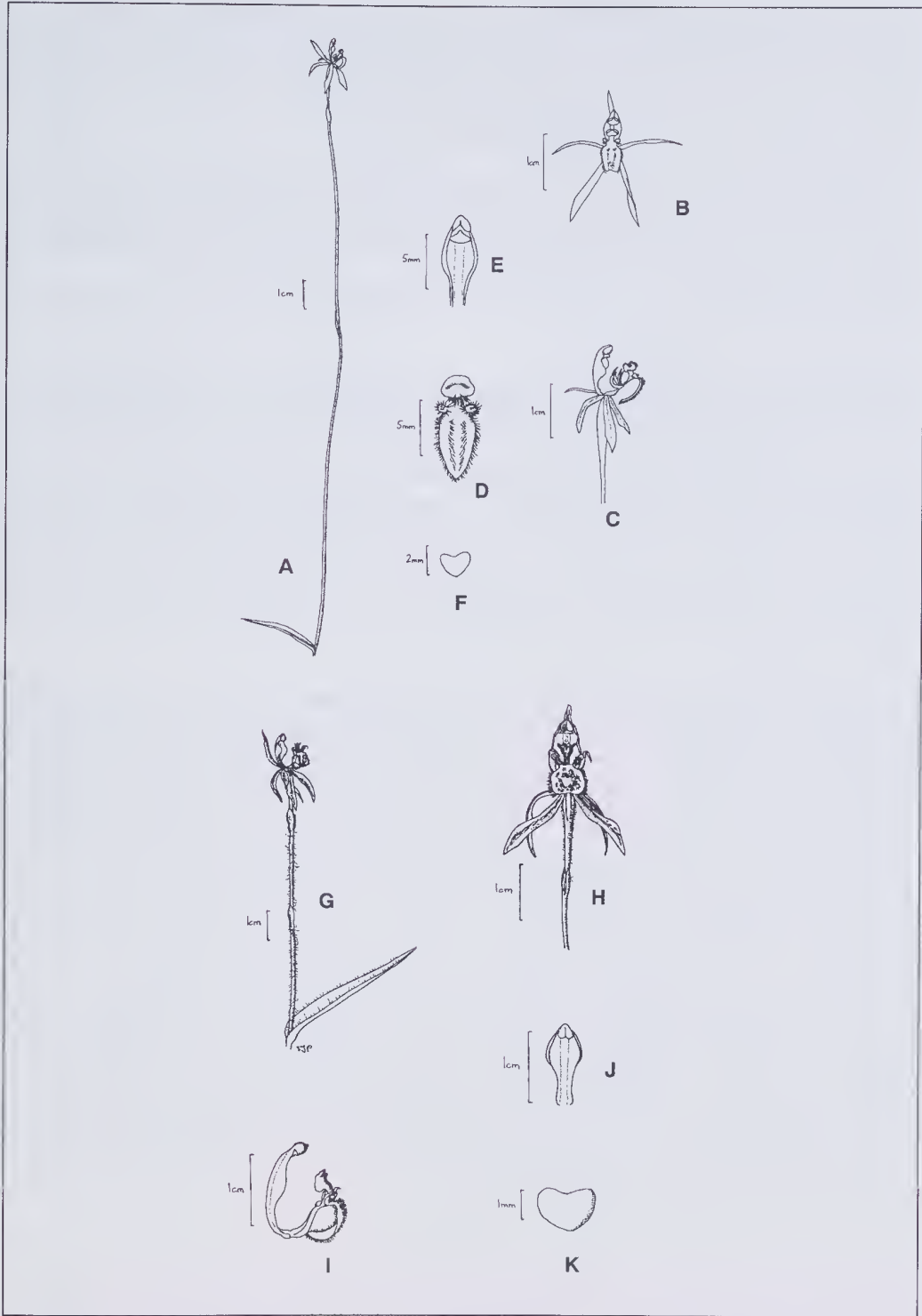


Figure 34. A–F. *Caladenia barbarella* from north of Kalbarri, A.P. Brown s.n. A – plant with leaf, B – flower from front, C – flower from side, D – labellum, E – column, F – pollinia; G–K. *Caladenia barbarossa*, from Stirling Range National Park, G.J. Keighery 3464. G – plant with leaf, H – flower, I – labellum and column from side, J – column, K – pollinia. Drawn by S.J. Patrick.

Notes. This species was first collected by A.S. George in 1969, and was surveyed for by us and S. van Leeuwen in the early 1980s. It was found to be sufficiently rare to be declared as Rare Flora under the Wildlife Conservation Act (Hopper *et al.* 1990; Brown *et al.* 1998). Presently, it is known from seven populations comprising several thousand plants, but all are confined to an area just a few hectares in size. One small population occurs in Kalbarri National Park.

Caladenia barbarella is similar to *C. drakeoides* in having a small labellum, but differs most noticeably in its stiffly hinged shorter claw c. 2 mm long that holds the abdomen above the top of the ovary. The species occurs much further north than other members of *Caladenia* subgenus *Drakonorchis*.

Caladenia barbarossa H.G. Reichb., *Beitr. Syst. Pflanzenk.* 64 (1871). Type: 'Swan River', J. Drummond 861 (*holo*: W; *iso*: G, K, P).

Drakonorchis barbarossa (H.G. Reichb.) Hopper & A.P. Br. *nom. inval.* in N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 192 (1992), rev. 2nd edn. with suppl., p. 192 (1998).

Illustrations. R. Erickson, *Orchids of the West*, 2nd edn, plate 28, Figure 9 [as *Caladenia barbarossa*] (1965); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 21 top photo [as *Caladenia barbarossa*] (undated); C. Woolcock & C. Woolcock, *Australian Terrestrial Orchids*, plate 11 B1 & B2 [as *Caladenia barbarossa*] (1984); C. Jones, *Native Orchids of Australia*, p. 108 [as *Caladenia barbarossa*] (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 150 [as *Caladenia barbarossa*] (1984), 2nd ed., p. 192, and rev. 2nd edn. with suppl., p. 192, [as *Drakonorchis barbarossa*] (1998).

Plant solitary or in small clumps. *Leaf* more or less prostrate, linear, 4–6 cm x 5–10 mm, pale green. *Scape* 10–30 cm tall. *Flowers* 1(2), c. 2–3 cm across, cream to greenish yellow with maroon stripes and markings; floral odour absent. *Sepals and petals* stiffly held, cream to greenish yellow with a thick medial linear maroon stripe, linear-lanceolate, shortly constricted at apex, glabrous, lacking a tumescent osmophore. *Dorsal sepal* erect, 1.8–2.5 cm x 1.5–2 mm. *Lateral sepals* obliquely descending off horizontal well away from ovary, 1.8–2.5 cm x 2–5 mm, basal 2/3 narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to the slightly incurved apex. *Petals* obliquely descending off horizontal well away from ovary with apex slightly incurved, 1.4–2.4 cm x 1.5–2.0 mm. *Labellum* cream to greenish-yellow with dark maroon hairs and calli, stiffly articulated on a claw 3–5 x 2–3 mm held obliquely upwards; claw connection c. 1 x 2.5 mm; abdomen vertical to recurved, held above the top of the ovary, ovate with rounded entire hirsute margins in outline when flattened, 8–10 x 6–8 mm, 1-lobed, obliquely descending outwards then recurved in the apical 2/3, terminating in an undifferentiated deeply channelled tail, margins at widest point vertical and flat, with 2 longitudinal rows of simple hairs converging near the tail. *Shoulder calli* robust, columnar, slightly capitate, about 1.5–2.0 mm tall; head shortly mallet-like, 2.5–3 mm wide, dark plum to black with two pronounced antenna-like lateral anterior swellings. *Column* 13–16 mm x 5–7 mm, broadly winged, translucent greenish-cream with maroon markings. *Anther* c. 2–3 x 2–3 mm, greenish-yellow. *Pollinia* c. 2 x 1 mm, yellow. *Stigma* c. 3 mm wide. *Capsule* not seen. (Figure 34G–K).

Selected specimens examined. WESTERNAUSTRALIA: Borden–Bremer Bay road, directly opposite Nightwell South Rd, due E of Amelup, 34°14'S, 118°24'E, 14 Oct. 1986, A. Brown 469 (PERTH 00928690); just E of Tone River on Kulikup–Frankland road, 34°07'S, 116°47'E, 3 Nov. 1977, A.S. George 15037 (PERTH 00248681); 3.4 km W of Drummond Track on Old Ongerup Rd, 3.2 km E of Susetta River, 33°48'S, 119°28'E, 4 Oct. 1984, S.D. Hopper 4190 (PERTH 00248150); Calyerup Rock,

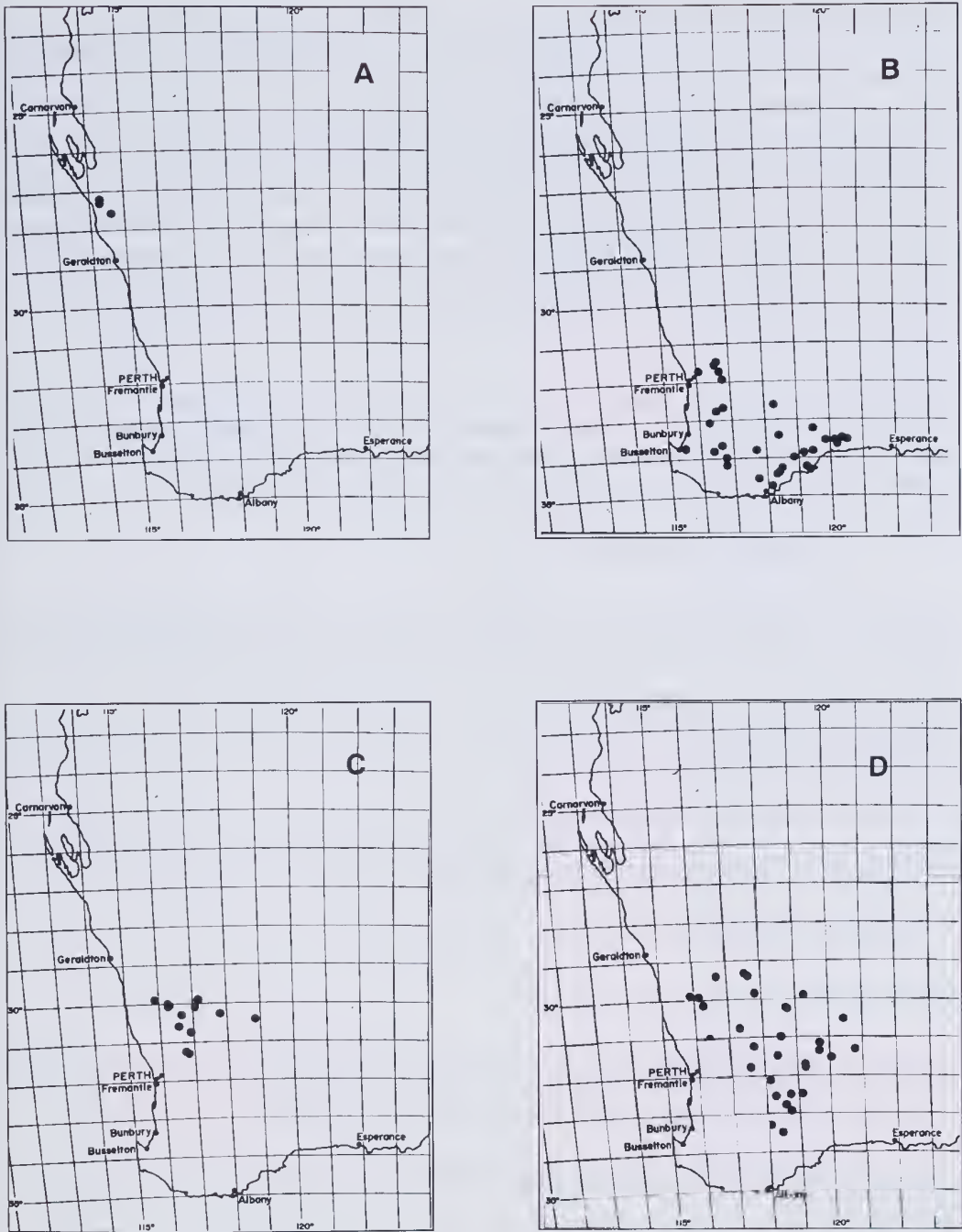


Figure 35. Distribution maps. A – *Caladenia barbarella*; B – *C. barbarossa*; C – *C. drakeoides*; D – *C. mesocera*.

16 km ENE of Jerramungup, 38 km WSW of Fitzgerald, 33°54'S, 119°05'E, 4 Oct. 1984, *S.D. Hopper* 4204 (PERTH 00248703); 100 m N of Pallinup River Bridge on W side of Hassell Rd, 5 km south of Boxwood Hill, 34°25'S, 118°14'E, 6 Oct. 1984, *S.D. Hopper* 4237 (PERTH 00248207); 11.6 km W of Williams on Williams–Pinjarra road, 33°04'S, 116°15'E, 17 Sep. 1985, *S.D. Hopper* 4619 (PERTH 00902209); 5 km S of Bannister Roadhouse, 8.2 km N of Hotham River Bridge, 32°43'S, 116°32'E, 27 Sep. 1987, *S.D. Hopper* 6117 (PERTH 00902195); Aerodrome Rd, 500 m W of Thomas Rd, on a bend turning WNW, c. 13 km NE of Ravensthorpe, 33°33'S, 119°55'E, 25 Sep. 1988, *S.D. Hopper* 6828 (PERTH 01711091); Papa Colla Creek, below Bluff Knoll, Stirling Range, 15 Aug. 1980, *G.J. Keighery* 3464 (PERTH 00248622); Dryandra State Forest, Narrogin map 1:100,000, Grid Reference 023730, 23 Sep. 1987, *C.M. Rose* 300 (PERTH 01699008); River Avon commonage near Mt Bakewell, York, 23 Oct. 1907, *O.H. Sargent s.n.* (PERTH 00257265); Boyup Brook, Oct. 1924, *C.L. Serventy s.n.* (PERTH 00257796).

Distribution and habitat. Widespread in the western and southern wheatbelt from the Jerdacuttup River, east of Ravensthorpe to near Bindoon. Usually found in moist situations adjacent to rivers and swamps. It often forms dense colonies under thickets of sheoak (*Allocasuarina*) and in areas of Wandoo woodland. Soils are variable but consist mainly of grey sandy clay. (Figure 35B)

Flowering period. September to November.

Notes. Found throughout the western and southern wheatbelt, *Caladenia barbarossa* is the most common of the *Caladenia* subgenus *Drakonorchis* species. It is often seen in large colonies under thickets of sheoak (*Allocasuarina*) adjacent to river courses and in moist depressions in areas of open Wandoo woodland. *C. barbarossa* is most like *C. mesocera*, differing essentially in its shorter, often more colourful petals and sepals, its broader, usually more hirsute labellum lamina and its more westerly and southerly distribution.

The species was first collected by James Drummond in 1839 from near Toodyay. Sargent (1907) published an early description of the pollination of this species by flower wasps, without realising that sexual deception mechanisms were involved (cf. Stoutamire 1983).

Caladenia barbarossa hybridizes with *C. longicauda* to produce *C. x enigma*.

Caladenia drakeoides* Hopper & A.P. Br., *sp. nov.

Drakonorchis drakeoides Hopper & A.P. Br. *nom. inval.* in N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 194 (1992) and rev. 2nd edn with suppl., p. 194 (1998), A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 83 (1998).

A *Caladenia mesocera* Hopper & A.P.Br. floribus parvioribus lamina labelli tremula et laxae articulata differt.

Typus: north-west of Dalwallinu, Western Australia, 23 August 1988, *S.D. Hopper* 6498 (*holo:* PERTH 01708066; *iso:* AD, CBG, K, MEL, NSW, PERTH 02416302).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 60 [as *Caladenia* sp. (salt lakes)] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 194 and rev. 2nd edn with suppl., p. 194, [as *Drakonorchis drakeoides*] (1998);

A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 83 [as *Drakonorchis drakeoides*] (1998).

Plant solitary or in clumps. *Leaf* more or less prostrate, linear, 3–6 cm x 4–12 mm, pale green. *Scape* 12–30 cm tall. *Flowers* 1(2), c. 2.6?? cm across, cream to greenish yellow with maroon stripes and markings; floral odour absent. *Sepals and petals* cream to greenish yellow with a thick medial linear maroon stripe, stiffly held, linear–lanceolate, shortly constricted at apex, glabrous, lacking a tumescent osmophore. *Dorsal sepal* almost horizontal to scarcely ascending backwards, 1.2–1.8 cm x c. 1.5 mm. *Lateral sepals* descending vertically and clasping the ovary, 1.2–1.8 cm x 3–4 mm, basal 2/3 narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to the slightly incurved apex. *Petals* descending vertically and clasping the ovary with the apex slightly incurved, 1.0–1.4 cm x 1.0–1.5 mm. *Labellum* cream to greenish-yellow with dark maroon hairs and calli, loosely articulate on a claw 2–3 x 1.5 mm held obliquely upwards; claw connection 3–4 x c. 1.5 mm; abdomen slightly curved longitudinally, obliquely descending towards the ovary, held below the top of the ovary, 5–6 x 3–4 mm, narrowly rhomboid with rounded entire hirsute margins in outline when flattened except for acute apex, 1-lobed, terminating in an undifferentiated deeply channelled tail, margins at widest point obliquely descending and flat, with 2 longitudinal rows of simple hairs converging near the tail. *Shoulder calli* small, hump-like, not capitate, c. 0.5–1.0 mm tall; head globular, 1.5–2 mm wide, golden brown with small dark red spots, with a cranial depression and two lateral anterior slight swellings (not antenna-like as in *C. barbarossa*). *Column* 10–12 x 4–6 mm, broadly winged, translucent greenish-cream with maroon markings. *Anther* c. 2 x 2 mm, greenish-yellow. *Pollinia* c. 1 x 1 mm, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 36)

Selected specimens examined. WESTERN AUSTRALIA: NW of Goomalling, 17 Sep. 1984, R. Bates 4162 (PERTH 00254959); ENE of Gunyidi, 11 Sep. 1986, A. Brown 406 (CBG, PERTH 00929670); E of Gunyidi, 20 Sep. 1986, A. Brown 416 (PERTH 00929662); ENE of Gunyidi, 20 Sep. 1986, A. Brown 418 (PERTH 00929654); NW of Goomalling, 25 Sep. 1984, S.D. Hopper 4162 (PERTH 00792381).

Distribution and habitat. Found in scattered populations on the elevated margins of salt lakes between Meckering, Lake Moore and the Watheroo district. Grows in open seasonally wet sites beneath scrub of species such as Broom Bush (*Melaleuca uncinata*), *M. cordata*, Jam and *Exocarpos aphyllus*. Soils are usually dark brown sandy loams. (Figure 35C)

Flowering period. August to September.

Etymology. Named after the genus *Drakea*, alluding in particular to the loosely hinged tremulous labellum that is also a prominent feature of the hammer orchids.

Notes. *Caladenia drakeoides* was first collected by James Drummond in the spring of 1844 while travelling north of Toodyay to the vicinity of Lake Moore. In a brief sentence, he described his discovery of *C. drakeoides* and recognized its generic affinities with *C. barbarossa* (the type specimen of which was Drummond 861):

“Near our first bivouac I gathered a singular Orchidaceous plant having the hinged lower lip of *Drakea* (sic) but with other characters which will probably refer it to the same genus with 861 of my large collection: only three plants could be detected in flower and one of them I put into spirits as you directed. Our present mode of travelling is not favourable for collecting Orchidaceae which require close investigation of particular spots in order to detect them ...”

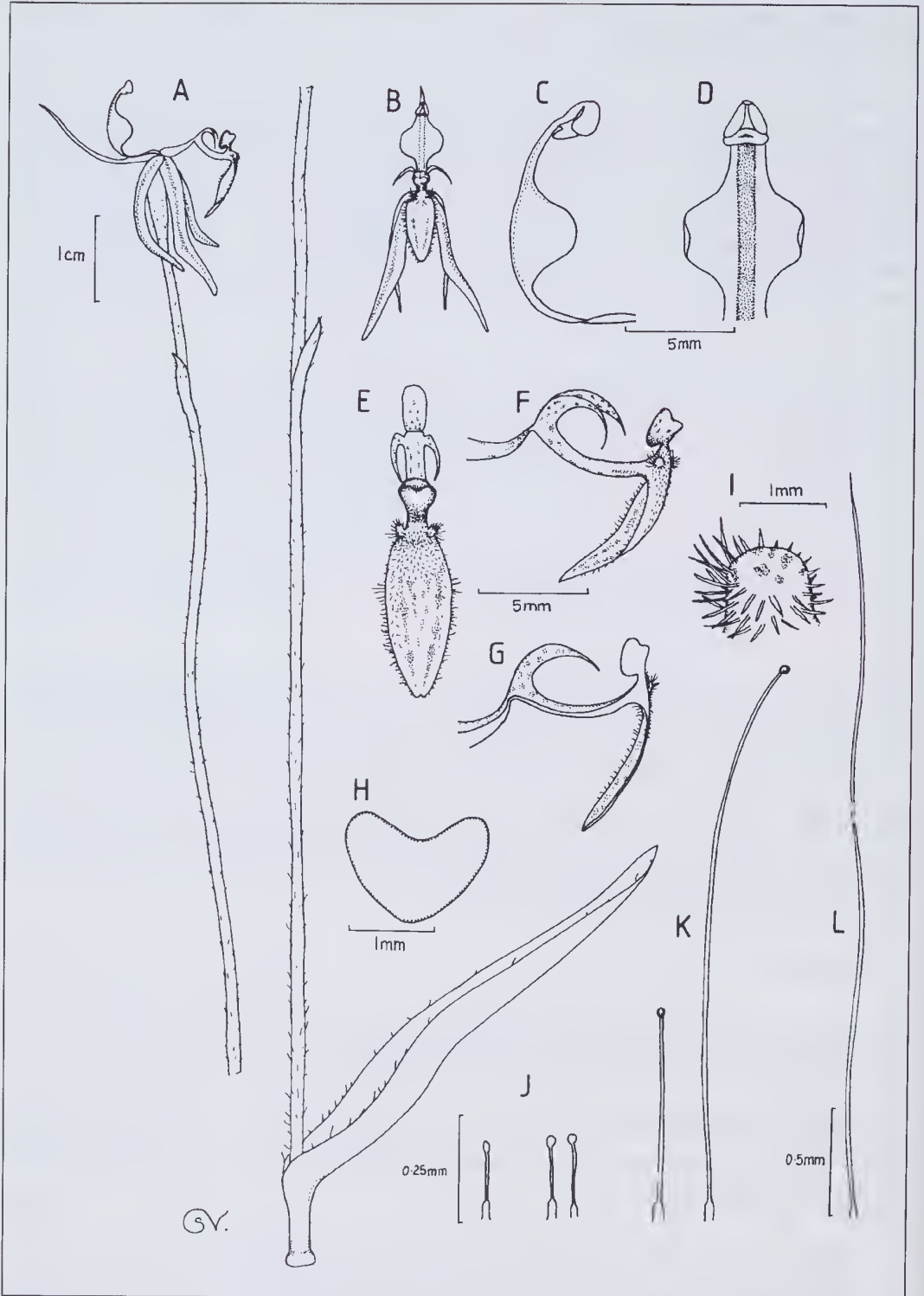


Figure 36. *Caladenia drakeoides*. from the Pithara area, A.P. Brown 870. A - plant; B - flower; C - column from side; D - column from front; E - flattened labellum from front; F - labellum from side; G - labellum, side section; H - pollinia; I - calli; J - ovary hairs; K - stem hairs; L leaf hairs. Drawn by C. Vasilu.

We were unable to trace this collection, and presume it did not survive if shipped back to England.

Lost to science for 120 years, *Caladenia drakeoides* was rediscovered by J. Tonkinson in the 1960s near Meckering. At the time, the species was thought to be an aberrant form of *C. barbarossa* (A.S. George, pers. comm.). It was not seen again until R. Bates from South Australia located a population near Goomalling in 1984. Subsequent surveys have located more populations further north, but the species was found to be sufficiently rare to be declared as Rare Flora under the Wildlife Conservation Act (Hopper *et al.* 1990; Brown *et al.* 1998). Much of the habitat of *C. drakeoides* is under threat through a combination of clearing, rising salt watertables and grazing by stock.

Caladenia drakeoides stands out in the subgenus in having the labellum on a loosely-hinged claw with a long claw connection. Rare hybrids of *C. drakeoides* x *C. exilis* subsp. *exilis* have been found and are named as *C. x ornata* in this paper.

Caladenia mesocera Hopper & A.P. Br., *sp. nov.*

Drakonorchis mesocera Hopper & A.P. Br. *nom. inval.* in N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 193 (1992) and rev. 2nd edn with suppl., p. 193 (1998).

A *Caladenia barbarossa* H.G. Reichb. appendicibus cornuatis in medio unguis labelli et lamina labelli elongata minus hirsuta differt.

Typus: Muddarning Hill, 3 km south-east of Mt Jackson, 69 km north-north-west of Koolyanobbing, 30°15'S, 119°18'E, Western Australia, 1 September 1984, S.D. Hopper 4010 (*holo*: PERTH 00250058; *iso*: AD, CBG, K).

Illustrations. R. Erickson, A. George, N. Marchant & M. Morcombe, Flowers and Plants of Western Australia, 1st edn, p. 122, plate 377 [as *Caladenia barbarossa*] (1973); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 193 and rev. 2nd edn with suppl., p. 193 [as *Drakonorchis mesocera*] (1998).

Plant solitary or in small clumps. *Leaf* more or less prostrate, linear, 4–8 cm x 4–10 mm, pale green. *Scape* 8–25 cm tall. *Flowers* solitary, c. 2.5–4 cm across, cream to greenish yellow with maroon stripes and markings; floral odour absent. *Sepals and petals* stiffly held, cream to greenish yellow with a thick medial linear maroon stripe, linear-lanceolate, shortly constricted at apex, glabrous, lacking a tumescent osmophore. *Dorsal sepal* obliquely ascending backwards, 2–3 cm x 2–3 mm. *Lateral sepals* obliquely descending off horizontal well away from ovary, 1.8–2.5 cm x 2.5–6 mm, basal 2/3 narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to the slightly incurved apex. *Petals* obliquely descending off horizontal well away from ovary with the apex slightly incurved, 1.5–2.4 cm x 1.5–2.0 mm. *Labellum* cream to greenish-yellow with dark maroon hairs and calli, stiffly articulate on a claw 3–4 mm x c. 2 mm held obliquely upwards; claw connection c. 1 x 1.5–2 mm; abdomen vertical to recurved, held above the top of the ovary, 10–15 x 3–7 mm, narrowly rhomboidal with rounded entire hirsute margins in outline when flattened except for pointed apex, single lobed, obliquely descending outwards then recurved in the apical 2/3, terminating in an undifferentiated deeply channelled tail, margins at widest point vertical and flat, with 2 longitudinal rows of simple hairs converging near the tail, and the shoulder calli. *Shoulder calli* robust, shortly columnar, not capitate, c. 0.5–1 mm tall; head shortly mallet-like with an oblong elongated face 2–3 mm wide, dark plum to black, lacking a cranial depression but with

two pronounced lateral anterior swellings (not antenna-like as in *C. barbarossa*). Column 12–16 x 6–8 mm, broadly winged, translucent greenish-cream with maroon markings. Anther c. 2.5 x 2.5 mm, greenish-yellow. Pollinia c. 2 x 1 mm, yellow. Stigma c. 2.5 mm wide. Capsule not seen. (Figure 37)

Selected specimens examined. WESTERN AUSTRALIA: Lake Chinocup, c. 22 km E of Nyabing via Chindup road, 33°33'S, 118°25'E, 12 Aug. 1985, A. Brown 223 (PERTH 00906433); Pigeon Rock NNE end, 29 km S of Diemals, 103 km NNW of Koolyanobbing, 29°55'S, 119°16'E, 2 Sep. 1984, S.D. Hopper 4026 (PERTH 00249637); Weowanie Rock, 42 km ESE of Southern Cross, 31°08'S, 119°45'E, 4 Sep. 1984, S.D. Hopper 4046 (PERTH 00249653); Hyden Rock, 4.3 km E of Hyden, 62 km SE of Narambeen, SE corner of Rock, 32°27'S, 118°52'E, 5 Sep. 1984, S.D. Hopper 4076 (PERTH 00250066); SW edge of Lake Altham on Rasmussen Rd, 7.5 km E of Lake Grace–Pingrup road, 33°25'S, 113°27'E, 12 Sep. 1985, S.D. Hopper 4559 (PERTH 00901717); Gunyidi–Wubin road, 2.7 km west of Masons Rd, c. 43 km north-west of Dalwallinu, 30°08'S, 116°14'E, 23 Aug. 1988, S.D. Hopper 6499 (PERTH 01197797); Camel Soak, 3.3 km S of Croppers Rd on the Vermin Proof Fence road, c. 33 km E of Perenjori, 29°24'S, 116°37'E, 27 Aug. 1988, S.D. Hopper 6564 (PERTH 01197800); Wardagga Hill, SW of Paynes Find, 29°23'S, 117°30'E, 21 Aug. 1982, R. Peakall s.n. (PERTH 00929751); Mt Jackson, N of Southern Cross, 4 Sep. 1967, J. Tonkinson s.n. (PERTH 00254932); Mt Churchman, 3 Sep. 1963, S.B. Rosier 305 (PERTH 00254940).

Distribution and habitat. Widespread from Pingrup north to the Paynes Find area, often growing on granite rock outcrops, ironstone hills and salt-lake margins. Soils are always seasonally moist sandy to rocky loams. Associated vegetation varies considerably. At the type location, in a gully on a banded ironstone hill, it was scrub and thickets of *Exocarpos*, *Allocasuarina*, *Grevillea* and *Eucalyptus ewartiana*. On granite rocks, the species grows under scrub and thickets of species such as *Acacia lasiocalyx*, *Jam* and *Hakea recurva*. Around salt lakes, *Melaleuca* thickets predominate, sometimes with scattered *Eucalyptus sargentii*. (Figure 35D)

Flowering period. August to early October.

Etymology. Named from the Greek *meso* (middle) and *ceras* (horn), alluding to the medial position of the reclined horns between the labellum claw and claw connection, a feature that readily distinguishes *Caladenia mesocera* from *C. barbarossa*.

Notes. *Caladenia mesocera* is the most widespread species in the subgenus, occupying disjunct sites throughout the eastern wheatbelt and adjacent pastoral country and vacant Crown lands. There is noticeable variation in the species, particularly when salt-lake populations are compared with rock outcrop populations, but we have not completed sufficient research to draw taxonomic conclusions as yet. Possibly, additional segregate taxa will be recognized in the future.

Caladenia mesocera is readily recognized by its long, narrow labellum and the distinctive reclined horns placed between the claw and the claw connection. The species has been found at a few sites with *C. drakeoides* between Miling and Wubin without apparent hybrids.

Caladenia subgenus **Elevatae** [as *Elevata*] Hopper & A.P. Br., *Lindleyana* 15 (2): 120–126 (2000). *Typus*: *Caladenia flava* R.Br., lectotype *fide* Hopper & Brown (2000: 124).

Petals 0.7–2.4 cm long, held horizontally or obliquely upwards and slightly backwards. *Labellum* claw minute, less than 0.5 mm long, lacking paired horn-like appendages; *lamina* glabrous above,

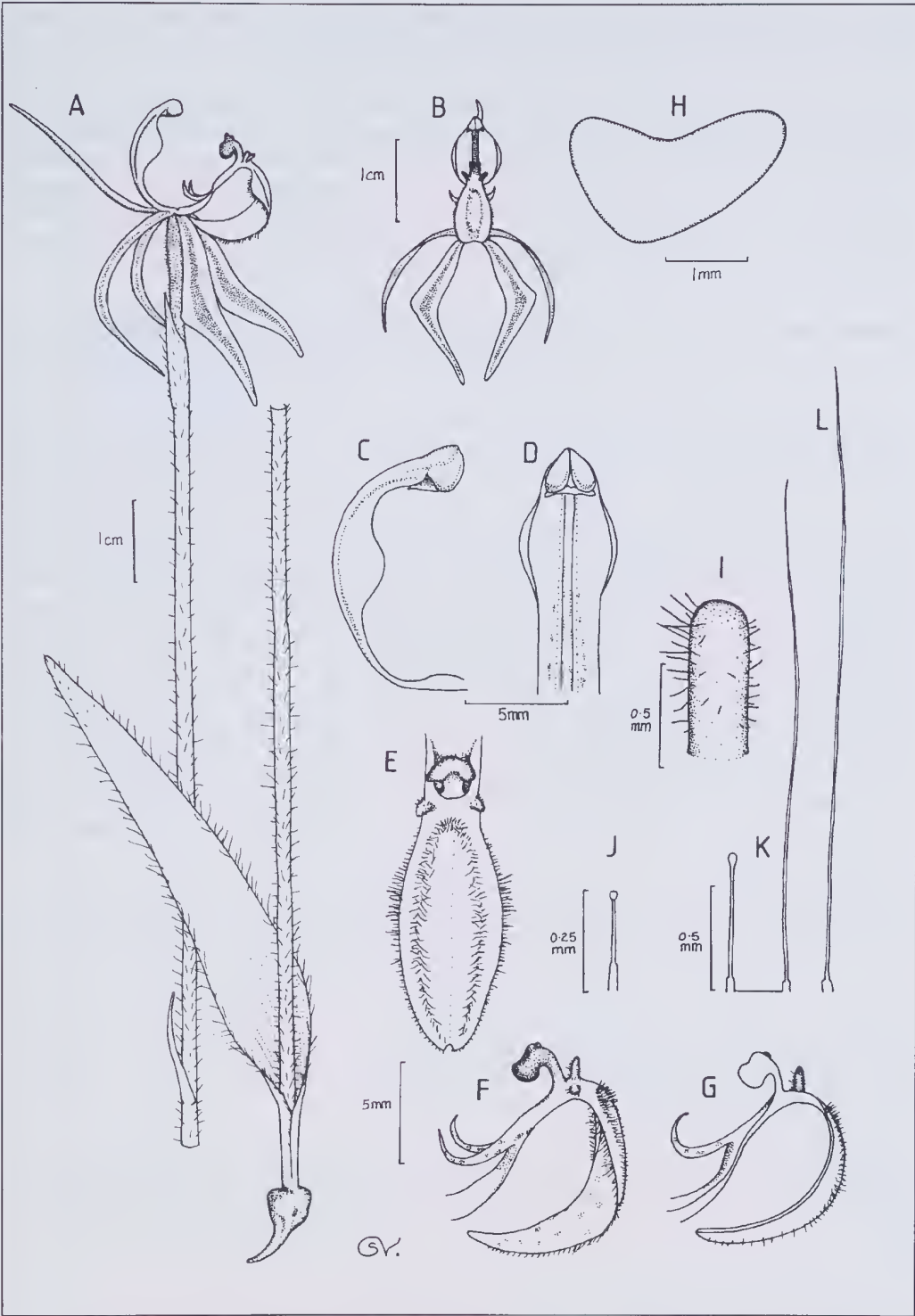


Figure 37. *Caladenia mesocera* from the Merredin area, S.D. Hopper 6715. A – plant with leaf; B – flower; C – column from side; D – column from front; E – labellum from front; F – labellum from side, G – labellum, side section; H – pollinia; I – calli; J – ovary hairs; K – stem hairs; L – leaf hairs. Drawn by C. Vasilu.

trilobed or triangular, with capitate calli connate at base, held aloft in 2 converging rows in a linear, semicircular or horseshoe pattern on the perimeter of a callus plate.

Notes. *Caladenia* subgenus *Elevatae* has five species, four endemic to south-western Australia, (*C. flava*, *C. marginata* Lindl., *C. nana* and *C. reptans*) and the fifth (*C. latifolia* R. Br.) in both south-western and south-eastern Australia and Tasmania. The five species share a distinctive arrangement of connate calli on an elevated plate. Otherwise the flower size and shape of members of *Caladenia* subgenus *Elevatae* aligns them with the fairy orchids in *C.* subgenus *Caladenia*. Indeed, recent DNA sequence studies of the *Caladenia* alliance in the *Diurideae* (Kores *et al.*, unpublished) established that these two subgenera are distinct clades basal to the genus as a whole.

***Caladenia flava* R.Br.**, Prod. 324 (1810). *Type*: King George's Sound, New Holland, [King George Sound, Western Australia], *A. Menzies s.n.* (*lecto*: BM! *fide* Clements (1989: 24); *isolecto*: BM! E!).

Plant clonal, in loose to dense clumps, rarely solitary. *Leaf* obliquely ascending, usually downcurved at apex, broadly linear, 5–15 cm x 10–15 mm, pale green on upper surface, green suffused with red on lower surface. *Scape* 10–30 cm tall. *Flowers* (1)2–5, c. 2–4 cm across, bright golden yellow or lemon yellow, sometimes with creamy yellow to white apices to the sepals and petals, and with prominent lines, spots or irregular markings of bright red, pink or brownish-fawn red; floral odour absent. *Sepals and petals* stiffly held, lacking an osmophore, apex shortly acute. *Dorsal sepal* erect, broadly lanceolate, 1.5–2.5 cm x 7–10 mm, acuminate, with prominent bright red, pink or brownish fawn markings usually centred on a strong medial line. *Lateral sepals* obliquely downcurved and spreading, broadly lanceolate, 2–4 cm x 7–15 mm, acuminate, usually lacking bright red, pink or brownish-fawn markings. *Petals* obliquely ascending, spreading, straight, ovate, 1.1–2.4 cm x 6–12 mm, acuminate, with prominent bright red, pink or brownish fawn markings usually centred on a strong medial line. *Labellum* prominently 3-lobed, golden yellow or lemon yellow, terminating in a creamy yellow to white straight horizontally projecting apex, stiffly articulate on a claw c. 1–1.5 mm wide; lamina hastate with lateral lobes projecting obliquely forward in outline when flattened, 10–15 x 10–13 mm, basal 1/5 curving from erect to horizontal, apical 4/5 horizontal except for lateral lobes, margins at widest point deeply curved upwards and terminated by vertically ascending calli; lateral lobes acute, with entire proximal margins, distal margins entire or fimbriate with few linear narrowly capitate obliquely ascending forward-facing calli to 2 mm long; midlobe margins fimbriate proximally with few linear narrowly capitate obliquely ascending to horizontal forward facing calli to 3 mm long, becoming entire towards acute apex. *Lamina calli* in 3–6 pairs held aloft in a semicircular or horseshoe pattern on the perimeter of a callus plate which is spherical to oblong when viewed from above, extending about a third the length of the lamina, erect to forward-facing, linear, acute, equal in length, to 1.5 mm, golden to lemon yellow, broadening and connate at base. *Column* 7–10 x 4–5 mm, broadly winged, lacking auricular lobes, golden to lemon yellow tinged with green. *Anther* c. 2 x 1–1.5 mm, yellow to pale red. *Pollinia* c. 1 mm long, aggregated in 4–7 broadly club-shaped united segments, yellow. *Stigma* c. 2 mm wide, yellow-green. *Capsule* not seen.

Distribution and habitat. Widespread throughout the south-west from Paynes Find and Nerren Nerren Station to Israelite Bay. Found in a variety of habitats from coastal heathlands, winter-wet swamps and forest areas to inland granite outcrops. Soils range from deep sands and sandy clays to heavy lateritic loams.

Flowering period. July to December.

Notes. *Caladenia flava* differs from *Caladenia latifolia* in its leaf consistently dull red beneath, its larger yellow, rather than pink, flowers, and its acute, not obtuse, lateral labellum lobes. *C. flava* is one of the most common widespread and variable species in south-western Australia. The red markings on the yellow flowers often differ among individuals within populations, enabling recognition and mapping of genetic clones. Our research on *Caladenia flava* indicates that three subspecies are recognizable.

Key to subspecies of *Caladenia flava*

1. Dorsal sepal with brownish-fawn spots. Labellum with 4–8 marginal calli each side on lateral and midlobe margins subsp. **maculata**
- 1: Dorsal sepal usually with maroon patches and stripes. Labellum with 2 or 3 marginal calli each side on midlobe margins only
 2. Scapes to 25 cm tall. Petals and lateral sepals bright yellow subsp. **flava**
 - 2: Scapes to 30 cm tall. Petals and lateral sepals lemon yellow, becoming white apically subsp. **sylvestris**

Caladenia flava R.Br. subsp. **flava**

Illustrations. W. Blackall & B. Grieve, *How to Know Western Australian Wildflowers*, Part 1, p. 95 (1954); R. Erickson, *Orchids of the West*, 2nd edn, plate 27 (1965); W. Nicholls, *Orchids of Australia*, plate 209 (1969); L. Cady & E. Rotherham, *Australian Native Orchids in Colour*, plate 48 (1970); D. Clyne, *Australian Ground Orchids*, p. 40 (1970); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 7 bottom photo (undated); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st edn, p. 20 plate 10 (1973); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 20 B1 & B2 (1984); J. Rentoul, *Growing Orchids Book Four The Australasian Families*, p. 56 (1985); D. Jones, *Native Orchids of Australia*, p. 88–89, 99 (1988); E. Bennett, *The Bushland Plants of Kings Park Western Australia*, Figure 221 (1988); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 160 (1984), 2nd edn, p. 147 (1992) and rev. 2nd edn. with suppl., p. 147 (1998).

Leaf 6–12 cm long. *Scape* 10–25 cm tall. *Dorsal sepal and petals* golden yellow with prominent bright red lines, spots or irregular markings centred on a strong medial line. *Lateral sepals* uniformly golden yellow, usually lacking bright red markings. *Labellum* golden yellow; lateral lobes with distal margins entire; midlobe margins with 2 or 3 calli each side. (Figure 30H–L)

Selected specimens examined. WESTERN AUSTRALIA: Twin Swamps Nature Reserve, 8 km S of Bullsbrook, 34°17'S, 116°01'E, 31 Oct. 1986, J.J. Alford 867 (PERTH 00873543); Boggy Lake, Walpole, Nov. 1958, D. Churchill s.n. (PERTH 00923338); Yandin Hill, Cataby, 4 km E along Yandin Rd from Brand Highway, 30°46'S, 115°36'E, 19 Aug. 1985, J. D'alonzo 60 (CANB, PERTH 00560340); Pallarup Rocks, SE of Lake King, 13 Sep. 1959, A.S. George 321 (PERTH 00248762); below Bluff Knoll, 15 Nov. 1959, A.S. George 431 (PERTH 00244023); NW base of Mt Ney, 33°24'S, 122°28'E, 7 Aug. 1980, A.S. George 15846 (PERTH 00262315); 43 km W of Binu, 8.3 km E of Ogilvie Rd, on Binu West Rd, 28°01'S, 114°14'E, 24 Aug. 1983, S.D. Hopper 3343 (CBG, PERTH 00248797); 18 km E of Dongara, along road to Mingenew, 200 m E of Table Top road junction, 29°13'S, 115°04'E, 25 Aug. 1983, S.D. Hopper 3362 (PERTH 00245925); 2 km N of Ocean Reef Rd on W side of Joondalup Drive, 31°45'S, 115°47'E, 3 Sep. 1985, S.D. Hopper 4480 (PERTH 00910147); Thomas Rd, 800 m SW of Anketell Rd, Oakford, W of Byford, 32°12'S, 115°56'E, 15 Oct. 1987, S.D.

Hopper 6234 (PERTH 00907499); Nornalup Rd, opposite Centre Rd, c. 11.3 km S of Muirs Highway, 34°36'S, 116°58'E, 26 Oct. 1987, *S.D. Hopper* 6267 (PERTH 01190296); Queen Victoria Rock SSW of Coolgardie, 31°18'S, 120°56'E, 13 Sep. 91, *S.D. Hopper* 8194a (PERTH 1829262).

Distribution and habitat. Widespread throughout the south-west between Geraldton and Israelite Bay, in a variety of habitats ranging from coastal heathlands, woodlands, winter-wet swamps and forest areas to inland granite outcrops. Soils vary from deep sand, sandy-clays and loams to heavy laterite. (Figure 33B)

Flowering period. August to December.

Notes. A common subspecies often found in large numbers in areas of suitable habitat, particularly in the season following summer fires. It differs from *Caladenia flava* subsp. *maculata* (which has lemon-yellow flowers with irregular brown-fawn markings, and its labellum with 4–8 marginal teeth each side) in its golden-yellow flowers with longitudinal maroon suffusions and stripes and fewer marginal teeth on the labellum, and from *C. flava* subsp. *sylvestris* it differs in its darker yellow flowers, lacking a white apex to the petals and sepals.

Caladenia flava subsp. *flava* often hybridizes with *C. latifolia* to produce an array of colour forms. This hybrid is formally described herein as *C. x spectabilis*. It also hybridizes with *C. nana*, *C. marginata* and *C. longicauda*, the latter cross producing the named hybrid *C. x triangularis*.

***Caladenia flava* R.Br. subsp. *maculata* Hopper & A.P. Br., subsp. nov.**

A subspecies typica floribus claris citrinis irregulariter notatis maculatis brunneo-hinnuleis differt.

Typus: Kalbarri National Park, 30 km east-north-east of Kalbarri, 300 m south-east of Z Bend Car Park, 27°39'S, 114°28'E, Western Australia, 24 August 1983, *S. D. Hopper* 3334 (*holo:* PERTH 00248355; *iso:* CBG!).

Illustrations. R.D. Fitzgerald, Australian Orchids, Vol. 2, Part 5, 7th plate, right hand paintings (1888, repr. 1979); E. Pelloe, West Australian Orchids, frontispiece colour plate no. 13 (1930); A.S. George & H.E. Foote, Orchids of Western Australia, p. 7 upper left photo (undated); K. Dixon, B. Buirchell & M. Collins (eds), Orchids of Western Australia – cultivation and natural history, front cover (1989); M. Hodgson & R. Paine, Field Guide to Australian Orchids, p. 66 (1989); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn., p. 148 (1992) and rev. 2nd edn. with suppl., p. 148 (1998).

Leaf 5–12 cm long. *Scape* 10–15 cm tall. *Dorsal sepal and petals* bright lemon yellow with prominent brownish-fawn spots or irregular markings, usually lacking a strong medial line. *Lateral sepals* uniformly lemon yellow, usually lacking brownish-fawn markings. *Labellum* lemon yellow; lateral lobes with distal margins fimbriate; midlobe margins with 4–8 calli each side. (Figure 30M–P)

Selected specimens examined. WESTERN AUSTRALIA: Z Bend Gorge, Kalbarri National Park, 27°39'S, 114°28'E, 21 Aug. 1984, *A. Brown s.n.* (PERTH 00929166); North West Coastal Highway, c. 9 km S of the Kalbarri–Ajana road, 27°58'S, 114°41'E, 20 Aug. 1984, *A. Brown s.n.* (PERTH

00929735); 15 km W of the North West Coastal Highway on the State Barrier Fence, 27°17'S, 114°29'E, 19 Aug. 1981, A. Brown s.n. (PERTH 00929123); 4.4 km NE of Moonyoonooka turnoff on Nanson–Geraldton road, on Heinrichs Farm, 28°40'S, 111°43'E, 25 Aug. 1983, R.J. Cranfield 2896 (PERTH 00244902); 29 km SW of Cooloomia Homestead, 60 km WNW of Nerren Nerren Homestead, 27° 03' S, 114° 03' E, 23 Aug. 1983, S.D. Hopper 3319 (PERTH 00249238); 13 km W of Mt Horner, 5.8 km E of Brand Highway on Mt Horner West Rd, 29°07'S, 114°57'E, 24 Aug. 1983, S.D. Hopper 3356 (PERTH 00248347); 15.4 km S of Northampton along North West Coastal Highway, 28°31'S, 114°7'E, 21 Aug. 1983, C.M. Lynch 14 (PERTH 00244899).

Distribution and habitat. Known from east of Perenjori to Nerren Nerren station north of Kalbarri in a variety of habitats from granite outcrops and rocky slopes to gorges to deep yellow sandplain. (Figure 33B)

Flowering period. August to September.

Etymology. Named from the Latin *maculatus* (spotted, blotched), alluding to the irregular brown-fawn blotching on the dorsal sepal and petals of this subspecies.

Notes. A common subspecies often found in large numbers in areas of favourable habitat. *Caladenia flava* subsp. *maculata* differs from other subspecies in its bright lemon yellow flowers with the dorsal sepal and petals irregularly marked with brown-fawn blotches rather than longitudinal maroon suffusions and lines, its labellum midlobe with 4–8 teeth on each margin and its more northerly distribution. Near Kalbarri it often hybridizes with *C. reptans* to produce a remarkable array of colour forms from orange through to pink.

***Caladenia flava* R.Br. subsp. *sylvestris* Hopper & A.P. Br., subsp. nov.**

A subspecies typica foliis gracilioribus, scapis, petalis sepalisque, scapis altioribus ad 30 cm, et floribus pallidioribus albidascensibus ad apicem petalorum sepalorumque differt.

Typus: Deeside Rd, 50 m north of Cattaminup Rd, south-east of Nyamup, 34°28'S 116°24'E, Western Australia, 29 October 1987, S.D. Hopper 6304 (*holo:* PERTH 00907480; *iso:* AD!, CBG!, K!, MEL!, NSW!, PERTH 02416344).

Illustrations. A.S. George & H.E. Foote, Orchids of Western Australia, p. 7 upper right photo (undated); M. Pocock, Ground Orchids of Australia, photo 21B (1972); D. Jones, Native Orchids of Australia, pp. 10–11, 48, left side of photo, [*as Caladenia flava*] (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 149 (1992) and rev. 2nd edn with suppl., p. 149 (1998).

Leaf 5–15 cm long. *Scape* 12–30 cm tall. *Dorsal sepal and petals* lemon yellow basally, becoming creamy white apically, with prominent bright red or pink spots or irregular markings centred on a strong medial line. *Lateral sepals* 2-coloured, lemon yellow proximally, becoming creamy yellow to white apically. *Labellum* lemon yellow; lateral lobes with distal margins entire; midlobe margins with 2 or 3 calli each side. (Figure 38A–D)

Selected specimens examined. WESTERNAUSTRALIA: Broke Inlet, near Camfield Townsite, 12 Oct. 1969, A.S. George 9722 (PERTH 00244937); E side of Frankland River, Muir Highway, 34°29'S, 116°54'E, 2 Nov. 1977, A.S. George 15020a–c (PERTH 00848751); 22 km WNW of Nannup, junction

of Mowen Rd and Jalbarragup Rd, 18 km SW of Jarrahwood, 33°55'S, 115°33'E, 10 Oct. 1984, *S.D. Hopper* 4304 (PERTH 00248827); 3.4 km S of Bevan Rd on Thompson Rd, S of Lake Muir, 34°37'S, 116°42'E, 16 Oct. 1986, *S.D. Hopper* 5749 (PERTH 00860603); 24.3 km N along Deeside Coast Rd, from Chesapeake Rd, c. 35 km SE of Pemberton, 34°36'S, 116°21'E, 29 Oct. 1987, *S.D. Hopper* 6303 (PERTH 01710567); Sutton Rd, 0.8 km W of junction with Six Mile Rd, c. 20 km E of Pemberton, 34°26'S, 116°15'E, 29 Oct. 1987, *S.D. Hopper* 6308 (PERTH 01710575); 7 km along Stewart Rd, from Darradup, 8 Oct. 1981, *G.J. Keighery* 4061 (PERTH 00244503).

Distribution and habitat. Confined to the high rainfall southern forests between Bunbury and Albany, being especially common in Karri forest on dark loamy soils. Occasionally found colonizing the trunks of fallen trees. (Figure 33B)

Flowering period. October to December.

Etymology. Named from the Latin *sylvestris* (pertaining to woods), alluding to its occurrence in the tallest forests of south-western Australia.

Notes. A common plant usually growing as scattered individuals or small groups rather than in large colonies as seen in the other two subspecies. *Caladenia flava* subsp. *sylvestris* is distinctive in its slender habit, tall scapes and pale yellow to white flowers. It flowers much later than subsp. *maculata* and most populations of subsp. *flava*. Southern forest populations of subsp. *flava* reach their peak in early October, whereas subsp. *sylvestris* peaks in November. Hybrids with *Caladenia latifolia* and *C. nana* have been collected.

Caladenia nana Endl. in Lehm., Pl. Preiss. 2: 7 (1846). *Type:* in sand on the western flank of Mt Clarence (Albany), Western Australia, 5 October 1840, *Preiss* 2205 (*holo:* W!; *iso:* W!, G!).

Plant in loose to dense clumps. *Leaf* erect or horizontally spreading, linear to broadly linear, 5–18 cm x 3–10 mm, pale green, basal third usually irregularly blotched with red-purple. *Scapes* 5–40 cm tall. *Flowers* 1–6, c. 1–4 cm across, pale pink to rose pink, rarely white; floral odour sweet, like custard. *Sepals and petals* stiffly held, broadly lanceolate with an obtuse apex lacking a tumescent osmophore, abaxial surface evenly covered with minute capitate glandular hairs. *Dorsal sepal* erect and curving forward closely appressed to column, 0.7–1.7 cm x 2–7 mm. *Lateral sepals* united near base, spreading horizontally forward, 0.8–2.0 cm x 3–7 mm. *Petals* spreading horizontally outwards and curving forwards, 0.7–1.7 cm x 3–6 mm. *Labellum* prominently 3-lobed, white with conspicuous pink blotches and irregular markings, stiffly articulate on a claw c. 1.5–2 mm wide; lamina lobate in outline when flattened, 5–12 x 7–12 mm, basal 1/4 curving from erect to horizontal, apical 3/4 nearly horizontal with a slight apical downward curvature, margins at widest point deeply curved upwards and terminated by vertically ascending calli; lateral lobes erect, margins entire for most of their length, becoming scarcely fimbriate with one or two slender acuminate narrowly linear white with pink-tipped calli to 3 mm long which are even in size (not decrescent) near midlobe; midlobe margins with narrow forward-facing acuminate or obtuse calli decrescent, often uniting and broader, towards the apex; lamina calli in 2 rows extending at least 1/3 the length of the labellum, pinkish white, columnar-acuminate, the longest c. 1 mm tall, usually even in size, sometimes decrescent towards apex. *Column* 5–8 x 3–5 mm, scarcely winged, pale pink. *Anther* c. 2 x 2 mm, pink. *Pollinia* c. 1 mm long, congested in up to 8 globular masses, yellow. *Stigma* c. 2 mm wide, creamy yellow-green. *Capsule* not seen.

Distribution and habitat. Found between Perth and Bremer Bay in well drained soils in Jarrah forest and winter-wet flats amongst scattered paperbarks (*Melaleuca* spp.). Flowering of the species is

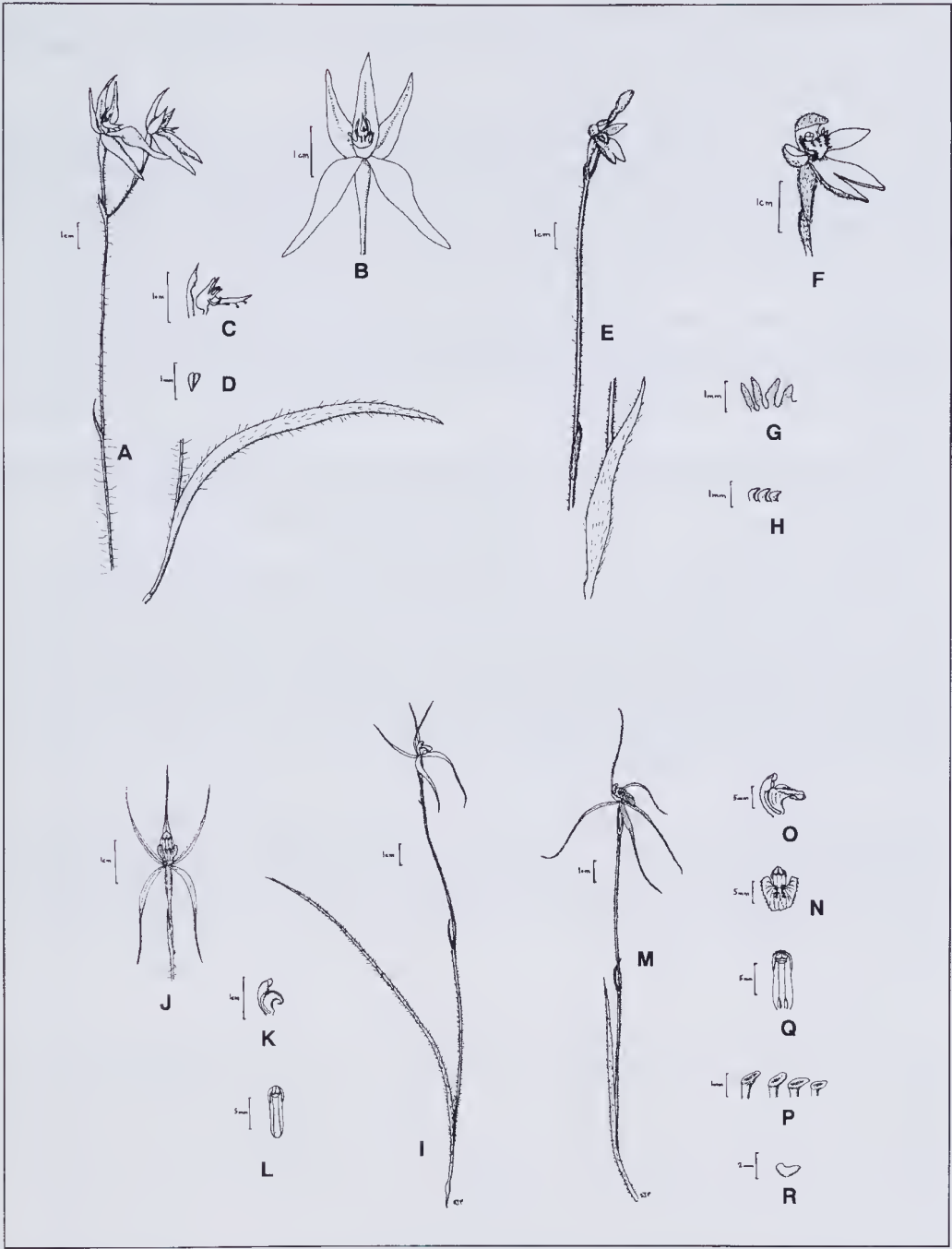


Figure 38. A–D. *Caladenia flava* subsp. *sylvestris* from the Manjimup area, A.P. Brown s.n. A – plant; B – flower from front; C – labellum and column from side; D – pollinia. E–H. *C. nana* subsp. *unita* from the Lake Muir area, A.P. Brown 491. E – plant; F – flower, G – labellum fringe; H – calli. I–L. *C. bicallata* subsp. *bicallata* from the Arrowsmith area, A.P. Brown s.n. I – plant; J – flower from front; K – labellum and column from side; L – column from front; M–Q. *C. caesarea* subsp. *caesarea* from Kojonup area, A.P. Brown 259. M – plant; N – labellum and column from front; O – labellum and column from side; P – calli; Q – pollinia. Drawn by S.J. Patrick.

triggered by fire. Unburnt populations typically produce leaves only in spring.

Flowering period. September to November.

Notes. The status of this species including *Caladenia unita* Fitzg. has been disputed. Reichenbach (1871) considered *C. nana* to be conspecific with the earlier named *C. reptans*. Bentham (1873) followed Reichenbach in "Flora Australiensis". Consequently, Fitzgerald (1882) named *C. unita* as a new species, apparently unaware of Endlicher's *C. nana*. Diels (1903), in a largely overlooked publication (though cited by Pelloe 1930), argued that *C. nana* was distinct from *C. reptans*.

The name *Caladenia unita* was applied widely this century (e.g. Pelloe 1930; Blackall & Grieve 1954; Erickson 1965; Nicholls 1969; Pocock 1972) until George (1971) argued that *C. unita* was conspecific with *C. nana*. This view was followed by Clements (1982), Hoffman & Brown (1984), and Jones (1988), who recognized only *C. nana*.

Most recently, Clements (1989: 31) reinstated *Caladenia unita* as a species distinct from *C. nana*. In so doing, he may have examined types of both taxa (he incorrectly cited a Huegel Swan River collection as the type of *C. nana*). When reinstating *C. unita* he argued:

"This taxon was formerly listed as a synonym of *Caladenia nana* (George 1971), but the two taxa are quite distinct. Fitzgerald described both taxa but illustrated only one. Fortunately the plant he illustrated is not *C. nana* but rather the second species. The lectotype has been chosen to fix the application of the name to the second taxon as it is also clear that most of the description was based on it. Plants of *C. unita* are generally a much taller (*sic*) and more robust, have larger flowers that expand fully when open compared to those found in *C. nana*. The porrect, broader labellum has longer side lobes on combs and more pronounced calli."

We have examined type material of *Caladenia nana* and *C. unita* and have studied numerous populations of both taxa in the field. We concur with Clements (1989) that two taxa are recognizable, and that both are included on the type sheet of *C. unita* from the British Museum (along with three specimens of *C. latifolia*). We also concur with Clements (1989) that specimens on this type sheet that most closely match Fitzgerald's illustration and protologue of *C. unita* match the taller and more robust second taxon (i.e. not *C. nana*).

As Clements did not indicate with a determinavit slip on the type collection exactly which specimen he intended to choose as lectotype of *Caladenia unita*, and this is not clarified in Clements' text quoted above, we have chosen the specimen labelled as the lectotype (determinavit S.D. Hopper 22 Feb. 1989). This specimen is directly above a label that reads "*Caladenia unita* (Gardn Chron. No. 432) Wilsons Inlet Western Australia, R.D. Fitzgerald Rec'd. June 1883". The lectotype has a scape 10 cm high to the first flower, with an unopened bud above it. There are six specimens of *C. unita* on the type sheet (i.e. specimens d-g, l, n = subsp. *unita*), intermixed with five of *C. nana* (h-k, m = subsp. *nana*).

Our field and herbarium studies have shown that while the two taxa are distinct in many populations, there are also many cases where this is not so and complete intergradation occurs. Because of this, subspecific rather than specific rank seems more appropriate.

Caladenia nana is similar in appearance to *C. reptans* and *C. latifolia*, from both of which it is most readily distinguished by its lateral sepals united near their bases, and the calli inserted directly into lamina surface, in two or more well spaced or densely aggregated rows. It also differs in the forward

curvature (not splayed straight outwards) of its petals, and its cucullate dorsal sepal curved forward and appressed to the column.

An interesting observation is that *Caladenia nana* flowers produce nectar, unlike the vast majority of caladenias.

Key to subspecies of *Caladenia nana*

1. Scapes short, 5–10(15) cm. Sepals 8–10 x 3–5 mm. Flowering late August to October. Well drained soils subsp. **nana**
- 1: Scapes tall 15–40 cm, rarely less. Sepals 11–19 x 5–7 mm. Flowering October to November. Winter-wet soils subsp. **unita**

Caladenia nana Endl. subsp. **nana**

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 142 (1992) and rev. 2nd edn with suppl., p. 142 (1998).

Plant in dense clumps. *Leaf* 5–9 cm long. *Scape* 5–10(15) cm tall. *Flowers* 1–3, c. 1–3 cm across, usually pale pink. *Sepals* 8–10 x 3–5 mm. *Petals* 8–10 mm x 3–4 mm. *Labellum lamina* 5–6 x c. 7 mm. *Column* 5–6 x 3–4 mm. (Figure 39)

Selected specimens examined. WESTERN AUSTRALIA: Broke Inlet, 12 Oct. 1969, A.S. George 9721 (K, NSW, PERTH 00870447); Bluff Knoll, below N side, Stirling Ranges National Park, 34°21'S, 118°14'E, 30 Sep. 1971, A.S. George 11089 (PERTH 00230138); Porongorups, Sep. 1930, B.T. Goadby s.n. (PERTH 00229253); Bunbury bypass on SE side, SE of Bunbury near Technical College, 33°22'S, 115°40'E, 9 Sep. 1985, S.D. Hopper 4510 (PERTH 00843261); Mowen Rd, c. 5.7 km E of Great North Rd, 33°56'S, 115°24'E, 10 Sep. 1985, S.D. Hopper 4523 (PERTH 00843245); Logue Brook Dam road, 2.5 km E of South West Highway, 32°59'S, 115°57'E, 17 Sep. 1985, S.D. Hopper 4610 (PERTH 00843253); S of Lake William, N of West Cape Howe via William Rd, 35°06'S, 117°36'E, 27 Oct. 1987, S.D. Hopper 6271 (PERTH 00843229); Dwellingup, 14 Sep. 1975, G. Hos 20/8 (PERTH 00230227); Walpole, off Highway 1, c. 6 km W of townsite, N side of Highway c. 300 m, 34°58'S, 116°42'E, 9 Oct. 1990, W. Jackson BJ190 (PERTH 01700030).

Distribution and habitat. Ranges from Perth to Albany, mainly in Jarrah forest in well-drained loams, or more rarely sands. (Figure 33C)

Flowering period. Late August to October.

Notes. *Caladenia nana* subsp. *nana* is a common diminutive orchid that differs from the less widespread subsp. *unita* in growing in distinct clumps, its shorter scapes, its smaller flowers, its earlier flowering season, and its occurrence in well-drained soils. Intergrades of the two subspecies occur where well-drained soils on slopes abut winter-wet flats and swamps. However, these intergrades are outnumbered substantially by pure populations of each subspecies in appropriate habitat.

Caladenia nana subsp. *nana* hybridizes occasionally with *C. flava*.

Caladenia nana Endl. subsp. **unita** (R. Fitzg.) Hopper & A.P. Br., *comb. et stat. nov.*

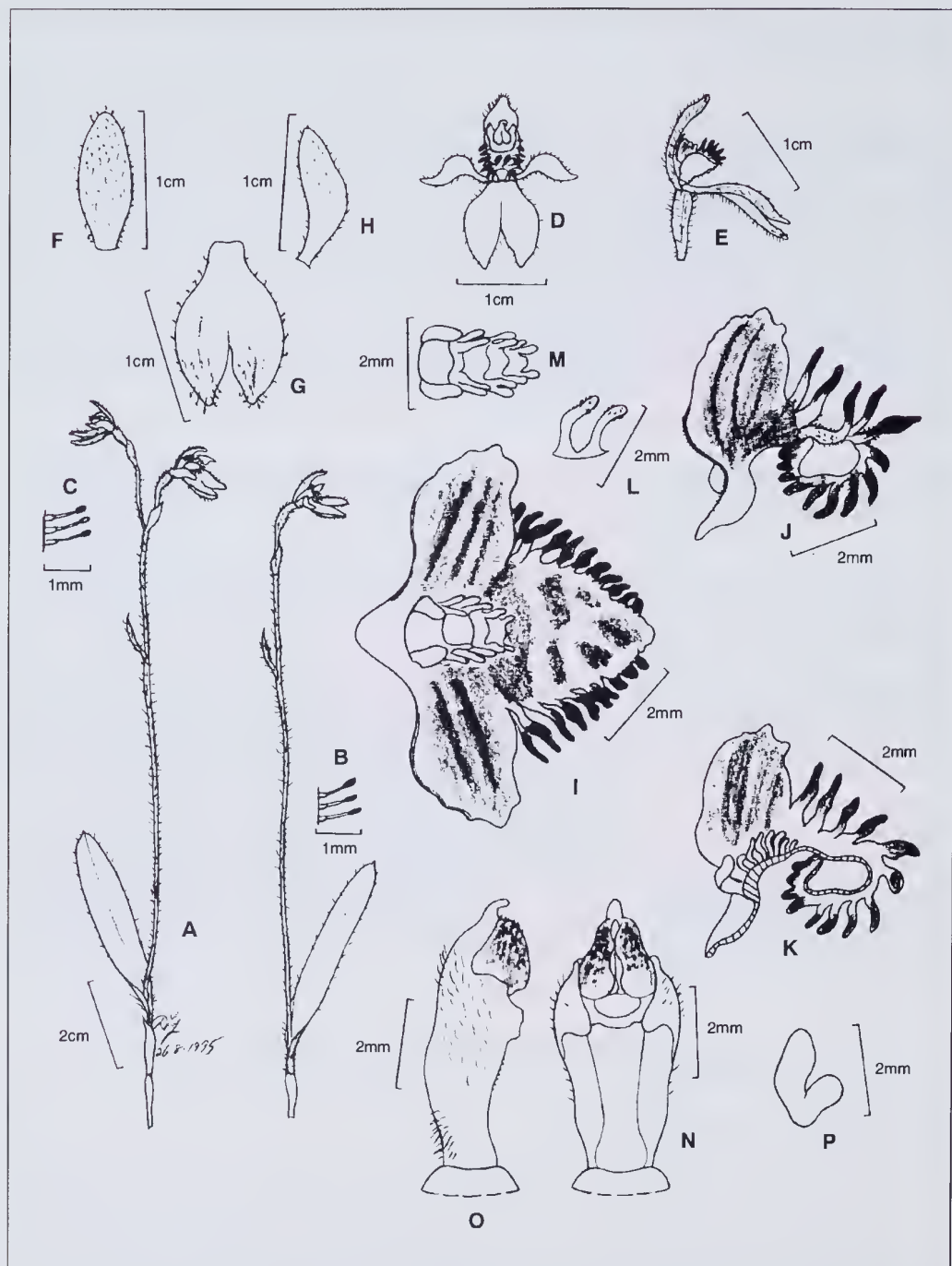


Figure 39. *Caladenia nana* subsp. *nana* from Johnson Rd, Mandogalup, D.L. Jones 14270. A – plant; B – hairs from lower scape; C – hairs from upper scape; D – flower from front; E – flower from side; F – dorsal sepal adaxial surface; G – lateral sepals abaxial surface from above; H – petal adaxial surface; I – labellum from above; J – labellum from side; K – labellum longitudinal section; L – labellum lamina calli in side view showing connate bases; M – basal callus plate from above; N – column from front; O – column from side; P – pollinia. Drawn by D.L. Jones.

Caladenia unita R. Fitzg., *Gard. Chron.* 17: 461 (1882). *Type*: Wilsons Inlet, Western Australia, *s.d.*, R.D. Fitzgerald *s.n.* (*lecto*: BM!, specimen labelled 1, here chosen; *isolecto*: BM d,g,m).

Illustrations. R.D. Fitzgerald, *Australian Orchids* Vol. 2, Pt 5, 6th plate, middle painting (1888 repr. 1979); W. Nicholls, *Orchids of Australia*, plate 211, [as *Caladenia unita*] (1969); M. Pocock, *Ground Orchids of Australia*, photo 42, [as *Caladenia unita*] (1972); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 21D1, [as *Caladenia nana*] (1984); K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia – cultivation and natural history*, colour plate a opposite p. 2 (1989); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 81, [as *Caladenia unita*] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 168, [as *Caladenia nana*] (1984); 2nd edn, p. 143 (1992) and rev. 2nd edn with suppl., p. 143 (1998).

Plant in loose clumps. *Leaf* 8–18 cm long. *Scape* 15–40 cm (rarely less) tall. *Flowers* 1–6, c. 2–4 cm across, usually rose pink. *Sepals* 11–19 x 5–7 mm. *Petals* 12–17 x 4–6 mm. *Labellum lamina* 7–12 x 7–12 mm. *Column* c. 7 x 5–6 mm. (Figure 38E–H)

Selected specimens examined. WESTERN AUSTRALIA: Muirs highway, c. 200 m W of Thompsons Rd, 34°27'S, 116°38'E, 16 Oct. 1986, A. Brown 491 (PERTH 00928674); Busselton, Sep. 1929, E. Coleman B2961 (PERTH 00229660); Boyup Brook, 1909, *Corkers s.n.* b (PERTH 01932462); Broke Inlet, 12 Oct. 1969, A.S. George 9721 (K, NSW, PERTH 00230189); Yallingup, 8 Oct. 1967, A.S. George *s.n.* (PERTH 00229210); S of Porongorups, 29 Aug. 1957, A.S. George *s.n.* (PERTH 00918067); 11 km W of Northcliffe on Richardson Rd, 15 km N of Warren Beach, 34°37'S, 116°00'E, 9 Oct. 1983, S.D. Hopper 3549 (PERTH 00230235); Fish Road Reserve, S of Busselton, 33°44'S, 115°24'E, 25 Oct. 1987, S.D. Hopper 6251 (PERTH 00843237); Hassell National Park on the Hassell Highway 12 km NE of Manypeaks, 34°47'S, 118°16'E, 7 Oct. 90, S.D. Hopper 7887 (PERTH 1828835); 2.7 km along Governor Broome Rd, from Courtney Rd, Brennans Ford, 3 Oct. 1982, G.J. Keighery 5576 (PERTH 00230200); Capel, 10 Oct. 1944, R.D. Royce *s.n.* (PERTH 00229679).

Distribution and habitat. A locally common subspecies ranging from Yarloop to Albany, but confined to sporadic populations in winter-wet swamps and flats. Associated vegetation is often low heath with scattered *Xanthorrhoea* and low trees. (Figure 33C)

Flowering period. October to late November.

Notes. *Caladenia nana* subsp. *unita* is usually much taller with larger, more richly coloured flowers than *C. nana* subsp. *nana*. Consequently, it has been illustrated much more frequently in orchid books. Attractive hybrids are known with *C. flava* as the other parent.

Caladenia reptans Lindl. in *Edward's Bot. Reg.* 1–23: Swan River Append. lii (1840). *Type*: Swan River, [Western Australia], 1839, J. Drummond *s.n.* (*holo*: K-L! *iso*: FI, G, K!).

Plant in loose to dense clumps. *Leaf* horizontally spreading, broadly linear to linear, 4–15 cm x 6–12 mm, pale green, undersurface usually red-purple. *Scape* 1–25 cm tall. *Flowers* 1–3, c. 1–3 cm across, predominantly pale pink to dark pink; floral odour sweet. *Sepals and petals* stiffly held, broadly lanceolate with an obtuse apex lacking a tumescent osmophore, abaxial surface sparsely covered with minute capitate glandular hairs. *Dorsal sepal* horizontal to rising obliquely away from the column, 1.0–2.0 cm x 4–6 mm. *Lateral sepals* spreading horizontally forward, 1.0–2.0 cm x 4–6 mm, free near base. *Petals* spreading horizontally outwards, 0.9–1.8 cm x 4–6 mm. *Labellum* prominently 3-lobed,

2-coloured, white or pink with conspicuous pale to dark pink blotches, stripes and irregular markings, with a conspicuously dark pink apex; stiffly articulate on a claw c. 1 mm wide; lamina lobate in outline when flattened, 5–10 mm x 7–10 mm, basal 1/4 curving from erect to horizontal, apical 3/4 held straight just below horizontal, rarely with a slight apical downward curvature, margins at widest point deeply curved upwards and terminated by vertically ascending lateral lobes; lateral lobes with entire margins; midlobe margins entire basally, then with 2–8 pairs of narrow forward-facing acuminate or obtuse horizontal calli decrescent, often uniting and broader, towards the apex, the longest to 1.5 mm; lamina calli in 2 rows extending at least a third the length of the labellum, yellow with red-pink bases, tapering, narrowly pyramidal-acuminate, the longest c. 1 mm tall, slightly decrescent towards apex. *Column* 6–8 x 2.5–3 mm, scarcely winged, pale to dark pink. *Anther* c. 1.5 x 1.5 mm, pale to dark pink. *Pollinia* c. 1 mm long, congested in up to 8 globular masses, yellow. *Stigma* c. 1.5 mm wide, creamy yellow-green. *Capsule* not seen.

Distribution and habitat. A species occurring from Kalbarri to Augusta and east to the Mt Ragged area, often common in the Jarrah forest and Wandoo woodlands of the adjacent wheatbelt. Favours lateritic soils and well-drained sands on slopes and hill tops.

Flowering period. July to September.

Notes. *Caladenia reptans* has one of the widest geographical ranges of south-western orchids and has two subspecies. It is often confused with *C. latifolia*, but is readily distinguished by its generally more inland distribution, its dark pink labellum apex and its usually smaller leaves and few-flowered scapes. It also grows in densely aggregated clumps unlike the more widely-spaced scapes in colonies of *C. latifolia*. *C. reptans* flowers best after fire, whereas *C. latifolia* will flower well in unburnt communities. The species hybridizes with *C. flava* to form the often apricot-flowered *C. x spectabilis*.

Caladenia reptans is also similar to *C. nana*, but differs in its splayed petals and sepals, the dorsal sepal held away from the column, its free lateral sepals (not united at the base as in *C. nana*), and the laterally-splayed arrangement and smaller number of labellum marginal calli confined to the apical half of the mid-lobe.

Key to subspecies of *Caladenia reptans*

1. Leaves red-purple underneath. Flowers dark pink. Labellum white in basal 3/4, with few marginal calli (2–5 each side of the lamina) subsp. **reptans**
- 1: Leaves green underneath. Flowers pale pink. Labellum pale pink in basal 3/4, with several marginal calli (4–8 each side of the lamina) subsp. **impensa**

Caladenia reptans Lindl. subsp. **reptans**

Caladenia preissii Endl. in Lehm., Pl. Preiss. 2:7 (1846). Type: Preston Creek, Perth, Western Australia, 25 July 1839, Preiss 2208 (holo: W!).

Illustrations. W. Nicholls, Orchids of Australia, plate 213 (1969); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 172 (1984); C. Woolcock & D. Woolcock, Australian Terrestrial Orchids, plate 4A (1984); D. Jones, Native Orchids of Australia, p. 104 (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 144 (1992) and rev. 2nd edn with suppl., p. 144 (1998).

Leaf 4–8 cm long, underside red-purple. *Scape* to 15 cm tall. *Flowers* c. 1–2 cm across, predominantly

dark pink. *Dorsal sepal* 1.0–1.5 cm long. *Lateral sepals* 1.0–1.5 long. *Petals* 0.9–1.4 cm long. *Labellum* white in basal 3/4; midlobe margins with 2–5 pairs of calli.

Selected specimens examined. WESTERN AUSTRALIA: 10 km N of Bridgetown, on Boyup Brook road, 21 Sep. 1985, *R. Bates* 4235 (PERTH 00875139); Mt Beaumont, 29 Sep. 1983, *M.A. Burgman* & *S. McNee* MAB 2395 (PERTH 00240737); Gooseberry Hill, Kalamunda, 31°58'S, 116°03'E, 5 Aug. 1980, *R.J. Cranfield* 1378/80 (PERTH 00240281); Malyalling Rock, 12 km NE of Wickepin, 7 km ESE of Malyalling siding, 32°43'S, 117°37'E, 7 Sep. 1984, *S.D. Hopper* 4124 (PERTH 00240710); 4 km SW of Murchison House Station turnoff on Kalbarri road, 27°41'S, 114°15'E, 8 Aug. 1986, *S.D. Hopper* 5179 (PERTH 00860670); Weam Nature Reserve Number 29322, N side of Brookton–Aldersyde road, c. 11 km E of Brookton, 33°24'S, 117°06'E, 25 Aug. 1986, *S.D. Hopper* 5211 (PERTH 00860689); c. 1 km SW of turnoff to Walpole on Muirs Highway, near NW corner of Lake Muir along forest track, 34°27'S, 116°38'E, 13 Sep. 1977, *E.N.S. Jackson* 3288 (PERTH 00261831); West Mt Barren, Fitzgerald River National Park, 20 Sep. 1969, *K.R. Newbey* 2893 (PERTH 00308439); Mt Saddleback, on one way road, 32°57'S, 116°27'E, 28 Aug. 1980, *A.S. Weston* 12610 (PERTH 00240745).

Distribution and habitat. A locally common orchid often found in areas burnt by summer fire. Widespread from Kalbarri south to Augusta and eastwards to beyond Esperance (e.g. Mt Ragged). (Figure 33D)

Flowering period. July to September.

Notes. *Caladenia reptans* subsp. *reptans* is much more common and widespread than *C. reptans* subsp. *impensa*. It has conspicuously darker flowers, the leaf is darkly coloured beneath, and there are fewer marginal calli on the labellum.

***Caladenia reptans* subsp. *impensa* Hopper & A.P. Br., subsp. nov.**

A subspecie typica foliis aliquantum longioribus 3.5–15 cm longis et usque ad 10 mm lata subter viridibus, floribus dilutioribus roseis, et segmentis fimbriae labelli numerosioribus differt.

Typus: Z Bend Gorge, Kalbarri National Park, 27°39'S, 114°28'E, Western Australia, 21 August 1984, *A.P. Brown* s.n. (*holo:* PERTH 00929182; *iso:* AD!, CANB!, K!, MEL!).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 145 (1992) and rev. 2nd edn with suppl., p. 145 (1998).

Leaf 3.5–15 cm long, underside green. *Scape* to 25 cm tall. *Flowers* c. 1–3 cm across, predominantly pale pink. *Dorsal sepal* 1–2 cm long. *Lateral sepals* 1–2 cm long. *Petals* 0.9–1.8 cm long. *Labellum* pale pink in basal 3/4; midlobe margins with 4–8 pairs of calli.

Selected specimens examined. WESTERN AUSTRALIA: 3 km SE of Erupting Mud Rd on Nanson Rd, Carney, 28°34'S, 114°45'E, 29 Aug. 1983, *R.J. Cranfield* 3079 (PERTH 00240729); Kalbarri National Park, 30 km ENE of Kalbarri, 300 m SE of Z Bend Car Park, 27°39'S, 114°28'E, 24 Aug. 1983, *S.D. Hopper* 3335 (PERTH 00240702).

Distribution and habitat. Apparently confined to well-watered sand over sandstone on the upper slopes of the Murchison River gorge in Kalbarri National Park. Grows in *Acacia*, *Calothamnus*,

Melaleuca open scrub over low scrub and tall sedges. There is a single collection (*R.J. Cranfield 3079*, PERTH) from a lateritic hill top at Carney on the Nanson Rd that may be this subspecies but needs further investigation. (Figure 33D)

Flowering period. July to August.

Etymology. Named from the Latin *impensus* (ample, great, large, strong), alluding to the longer leaves and taller scapes of the subspecies than are seen in *Caladenia reptans* subsp. *reptans*.

Notes. *Caladenia reptans* subsp. *impensa* is a rare taxon that has often been confused with *C. latifolia*, but differs notably in its fewer-flowered, shorter scapes and its darker pink labellum apex. *C. latifolia* at Kalbarri is confined to coastal limestone soils, whereas *C. reptans* subsp. *impensa* occurs further inland. Interestingly, *C. reptans* subsp. *reptans* also occurs in Kalbarri National Park, but it too is more coastal than *C. reptans* subsp. *impensa*, growing near Kalbarri townsite in pale brown sand in a coastal thicket of *Acacia rostellifera*, *Anthocercis littorea* etc. (e.g. *S.D. Hopper 5179*).

Caladenia reptans subsp. *impensa* hybridizes with *C. flava* subsp. *maculata* to produce an array of colour forms from orange through to pink.

Caladenia subgenus **Phlebochilus** [as **Phlebochila**] (Benth.) Hopper & A.P. Br., *Lindleyana* 15 (2): 120–126 (2000). – *Caladenia* sect. *Phlebochilus* Benth., Fl. Austral. 6: 379 (1873). Type: *Caladenia cairnsiana* F. Muell., lectotype *fide* Hopper & Brown (2000: 126).

Petals usually longer than 2 cm, held obliquely or vertically downwards or upwards, and backwards, rarely c. horizontal. *Labellum* claw less than 1 mm long (except in *Caladenia multiclavia*), lacking paired horn-like appendages; lamina glabrous above, 3-lobed or triangular, with capitate calli free at base, inserted directly into lamina surface, in two well spaced rows or densely aggregated without rows evident.

Notes. *Caladenia* subgenus *Phlebochilus* has many species distributed across southern Australia, with 45 in Western Australia, and all but three of these 45 endemic to the south-west. In addition to the species treated below, the following species belong to this subspecies: *C. multiclavia* H.G. Reichb., *C. radialis* R. Rogers, *C. roei* Benth., *C. sigmoidea* R. Rogers and *C. wanosa* A.S. George.

Bentham (1873) named *Caladenia* sect. *Phlebochilus*, and included just three species – *C. cairnsiana*, *C. multiclavia* and *C. discoidea*. Recent DNA sequence studies of the *Caladenia* alliance (Kores *et al.* unpubl.) show that while the first two of these species are related, *C. discoidea* actually belongs in *C.* subgenus *Calonema* close to *C. hoffmanii*. Interestingly, the DNA sequence studies also established that members of the *C. filamentosa* group (*C. chapmanii*, *C. luteola*, *C. polychroma*) are more closely related to *C. cairnsiana* and *C. douchiae* than they are to members of *C.* subgenus *Calonema* such as the *C. patersonii/longicauda* complex with which they have been placed traditionally.

Caladenia subgenus *Phlebochilus* thus includes one of the great radiations of southern Australian spider orchids, the *Caladenia filamentosa* group. The subgenus also has diverse other taxa lacking long thread-like petals and sepals that are concentrated in south-western Australia, with a few such as *C. cardiochila* Tate found on the east side of the Nullarbor Plain.

Caladenia abbreviata Hopper & A.P. Br., *sp. nov.*

A Caladenia evanescens Hopper & A.P. Br. folio 8–20 cm longo et 4–5 mm lato, saepe ante anthesin marcido, petalis sepalisque prope basem luteis, petalis patentibus ad recurvatis, 2.5–5 cm longis et 2–3 mm latis, labello 10–13 mm longo et 7–9 mm lato, ad basem lineis latis fuscatis recurvatum versus apicem radiantibus transientibus irregularibus maculis, callis 8–13, paribus longitudine saltem 0.5 labellum extensis differt.

Typus: c. 1 km south of Cosy Corner Rd [north-west of Augusta] on track running along west boundary of Location 169, 700 m west of Caves Rd, 34°15'S 115°02'E, Western Australia, 11 Nov. 1986, A.P. Brown 530 (*holo:* PERTH 01751565; *iso:* AD, CBG, K, MEL, NSW, PERTH 01935135).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 27 (1992) and rev. 2nd edn with suppl., p. 27 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 8–20 cm x 4–5 mm, often withered when flowering, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–35 cm tall. *Flowers* 1–3, c. 5–7 cm across, yellow-cream (rarely suffused pink or dark red), with dark maroon lines, spots and blotches; floral odour faint, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3–4.5 cm x 2–3 mm. *Lateral sepals* spreading to downcurved, 3–5 cm x 2.5–4 mm. *Petals* erect to spreading or downcurved, 2.5–5 cm x 2–3 mm. *Labellum* yellow-cream with thick dark radiating basal lines becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw 2–3 mm wide; lamina linear-rhomboidal in outline when flattened, 10–13 x 7–9 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate with white-tipped broad truncate marginal calli decrescent towards the apex. *Lamina calli* in 8–13 pairs in 2 rows extending at least half the length of the labellum, creamy yellow, anvil-shaped, the longest c. 1 mm tall, decrescent distally. *Column* c. 12 x 5 mm, narrowly winged, creamy yellow with red blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 2–3 x 2–3 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 40)

Selected specimens examined. WESTERN AUSTRALIA: between Black Point and White Point, 7.1 km E of Spring Ocean track, 34°23'S, 115°31'E, 30 Oct. 1987, S.D. Hopper 6310 (PERTH); 4 km E of Augusta, Nov. 1991, B. Thomson s.n. (PERTH 02389797).

Distribution and habitat. Ranges from Yallingup south-east to William Bay in consolidated dunes near the south coast growing in heath and open low woodlands of Peppermint. (Figure 41A)

Flowering period. November to December.

Etymology. Named from the Latin *abbreviatus* (shortened), alluding to the petals and sepals, which are shorter than most Western Australian members of the *Caladenia filamentosa* complex.

Notes. Although poorly collected (Priority Two), this species has been found in recent years by members of the Western Australian Native Orchid Study and Conservation Group to be sporadic but widespread in suitable habitat along the south coast.

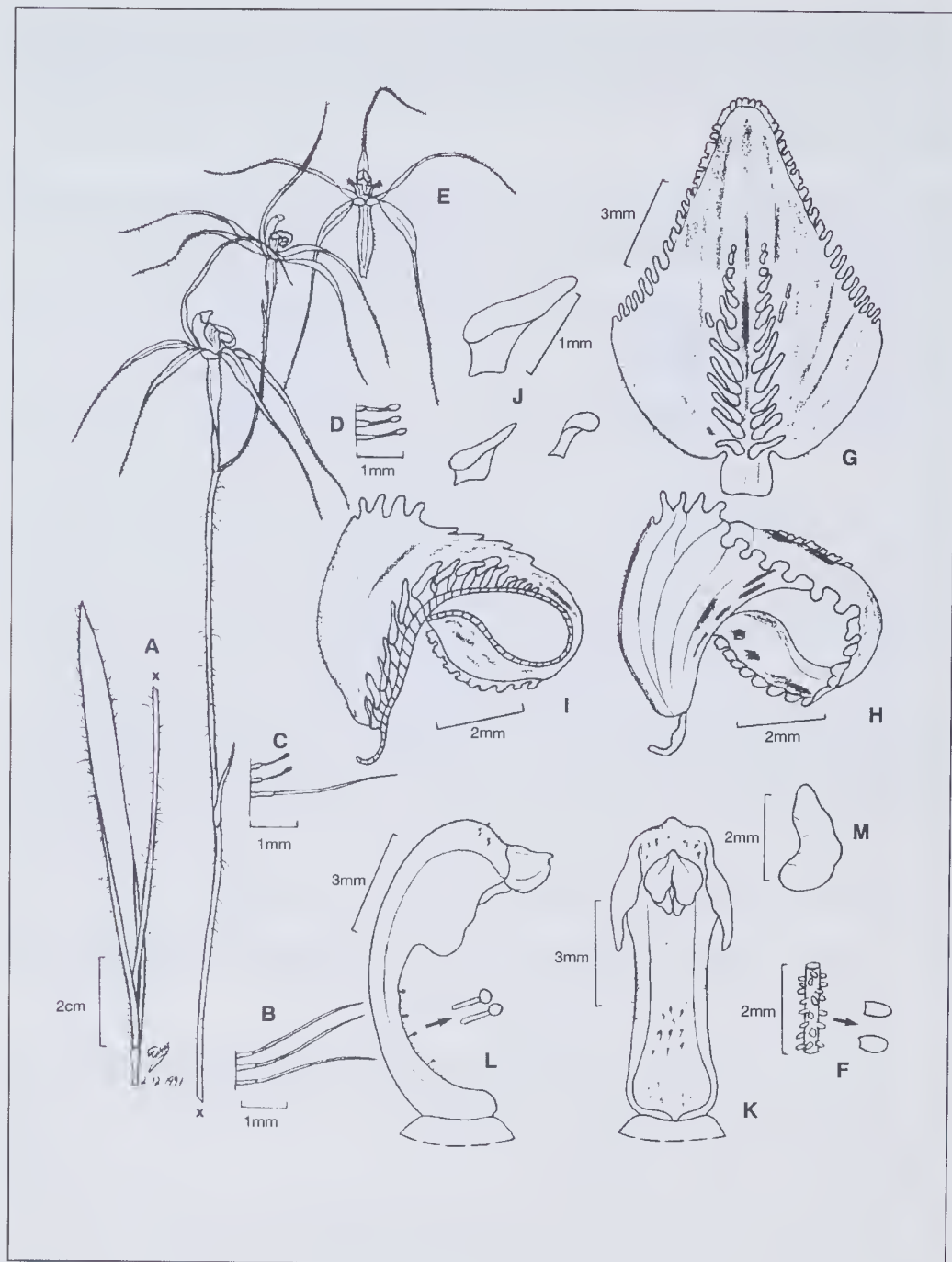


Figure 40. *Caladenia abbreviata* from Jingalup Swamp, A.P. Brown s.n. via D.L. Jones 8613. A – plant; B – hairs from lower scape; C – hairs from mid scape; D – hairs from upper scape; E – flower from front; F – glandular hairs from sepals; G – flattened labellum from above; H – Labellum from side; I – sectioned labellum from side; J – calli; K – column from front; L – column from side; M – pollinia. Drawn by D.L. Jones.

Caladenia abbreviata was first collected by A.P. Brown in 1986. Along with *Caladenia ultima* and *C. evanescens*, *C. abbreviata* flowers later than other members of the *C. filamentosa* complex found in Western Australia. *C. abbreviata* is most similar to *C. evanescens*, but differs in its yellow-cream flowers with longer petals and sepals, usually spreading to downcurved petals, and the labellum evenly recurved rather than thrust outwards.

Caladenia bicalliata R.S. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 33: 17 (1909). Type: Kingscote, Kangaroo Island, South Australia, 20 September 1908, J. Rogers s.n. (holo: AD).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–20 cm x 2–5 mm, pale green, basal third sparsely and irregularly blotched with red-purple, margins incurved. *Scape* 10–25 cm tall. *Flowers* dichogamous or cleistogamous, 1(2), c. 0.5–4 cm across, white to yellowish-cream with dark maroon lines, spots and blotches, and with dark apices on petals and sepals; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal half, then abruptly narrowing to a blackish brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, or strongly incurved to a horizontal apex, 1.2–3.5 cm x 1.5–2.5 mm. *Lateral sepals* spreading to downcurved, or erect and curved forward with a horizontal apex, 1.2–3.5 cm x 1.5–3 mm. *Petals* erect to obliquely spreading above horizontal, or erect and curved forward with a horizontal apex, 1.2–3 cm x 1.5–2.5 mm. *Labellum* white (occasionally yellow-cream) with thick dark radiating basal lines becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw 0.5–1.5 mm wide; lamina rhomboidal in outline when flattened, 5–10 x 4–8 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending calli, distal margins dentate with white-tipped broad truncate marginal calli decrescent towards the apex. *Lamina calli* in 10–16 pairs in 2 rows extending at least half the length of the labellum, white with red suffusions, anvil-shaped, the longest c. 0.5 mm tall, slightly decrescent distally. *Column* 8–11 x 2.5–6 mm, broadly to narrowly winged, white with red blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 1.5–2 x 1.5–2 mm, yellow or greenish-yellow. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen.

Distribution and habitat. In Western Australia, the species is found in coastal woodlands and dense coastal heath between the Zuytdorp cliffs north of Kalbarri and Israelite Bay. Soils are calcareous sands on consolidated dunes or over limestone outcrops.

Flowering period. August to October.

Notes. A distinctive often self-pollinating coastal species, with two subspecies. It is related to *Caladenia evanescens* and *C. abbreviata*, differing in its smaller flowers with shorter petals and sepals, longer (often more than 2/3 the length of the scape) somewhat narrower leaves with incurved margins and earlier flowering period.

Originally described from material from Kangaroo Island in 1909, *Caladenia bicalliata* was believed to be a South Australian endemic until the 1980s. Progressive collections then established its Western Australian distribution, and led to the recognition of a 1971 collection from William Bay (George 11110) as the first record for the State (this collection comprised specimens all of which had

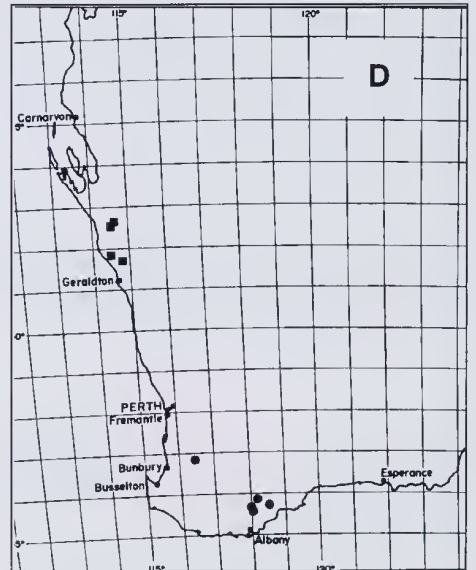
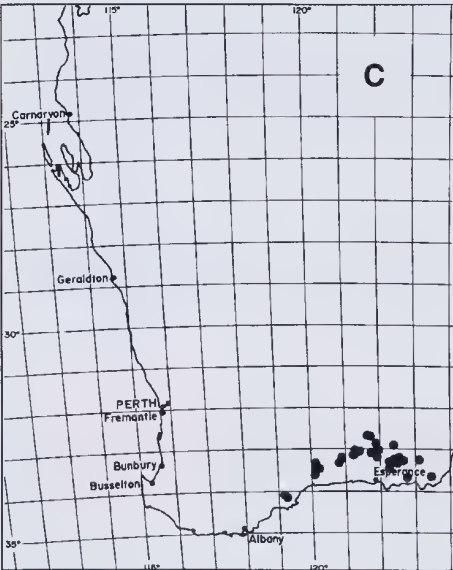
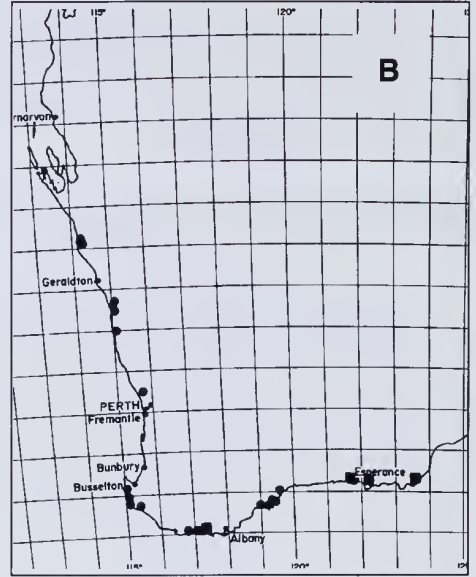
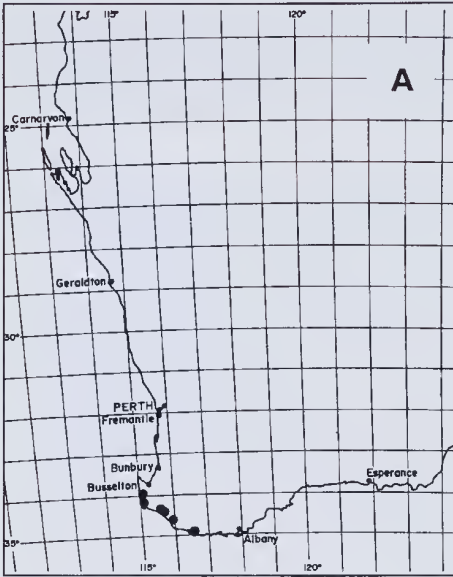


Figure 41. Distribution maps. A – *Caladenia abbreviata*; B – *C. bicallata* subsp. *bicallata* ● and *C. bicallata* subsp. *cleistogama* ■; C – *C. brevisura*; D – *C. bryceana* subsp. *bryceana* ● and *C. bryceana* subsp. *cracens* ■.

not opened and whose identity was not previously clear). There have also been recent collections of the species from the Victorian coast close to South Australia (Backhouse & Jeanes 1995).

Key to subspecies of *Caladenia bicallata*

1. Flowers dichogamous, c. 3–4 cm across. Lateral sepals 1.8–3.5 cm long, spreading to downcurved. Labellum lamina 7–10 x 5–8 mm.
Column 4–6 mm wide, broadly winged. subsp. **bicallata**
- 1: Flowers cleistogamous, c. 0.5 cm across (when closed). Lateral sepals 1.2–1.5 cm long, erect and curved forward with an horizontal apex.
Labellum lamina 5–6 x 4–5 mm. Column 2.5–3 mm wide, narrowly winged. subsp. **cleistogama**

Caladenia bicallata R.S. Rogers subsp. **bicallata**

Caladenia filamentosa R.Br. var. *bicallata* (R.S. Rogers) J. Weber & R. Bates in Black, Fl. S. Austral. 3rd edn 1: 395 (1978).

Illustrations. W. Nicholls, Orchids of Australia, plate 242 (1969); J. Weber & R. Bates, Orchidaceae, in Jessop, J.P. & Toelken, H.R. (eds), Flora of South Australia. Part IV, 4th edn, figure 944A (1986); D. Jones, Native Orchids of Australia, p. 109 (1988); M. Hodgson & R. Paine, Field Guide to Australian Orchids, p. 58 (1989); R. Bates & J. Weber, Orchids of South Australia, plate 26 (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 25 (1992) and rev. 2nd edn with suppl., p. 25 (1998).

Flowers dichogamous, c. 3–4 cm across. *Dorsal sepal* erect and slightly incurved, 2–3.5 cm x 2–2.5 mm. *Lateral sepals* spreading to downcurved, 1.8–3.5 cm x 2–3 mm. *Petals* erect to obliquely spreading above horizontal, 1.8–3 cm x 2–2.5 mm. *Labellum* articulate on a claw 1–1.5 mm wide; lamina 7–10 x 5–8 mm. *Lamina calli* in 13–16 pairs. *Column* 4–6 mm wide, broadly winged. (Figure 381–L)

Selected specimens examined. WESTERN AUSTRALIA: Barry Berger's farm, just S of the S boundary to the Kalbarri National Park, 27°53'S, 114°11'E, 23 Aug. 1982, A. Brown s.n. (PERTH 00249122); Bayside Busselton, 13 Sep. 1989, E. Lowe s.n. (PERTH 01709550); 22 km SSE of Kalbarri, 45 km WNW of Binnu, 27°54'S, 114°12'E, 24 Aug. 1983, S.D. Hopper 3339 (CBG, PERTH 00249106); 10 km SE of Leeman, Davies West Track, 9.6 km W of Cockleshell Gully Rd along Coorow–Greenhead road, 30°02'S, 115°01'E, 19 Sep. 1983, S.D. Hopper 3384 (PERTH 00249157); 21.5 km SE of Dongara, 3.5 km E of Brand Highway along Mt Adams Rd, 29°25'S, 115°03'E, 20 Sep. 1983, S.D. Hopper 3390 (PERTH 00249165); c. 2 km SE of Bremer Bay store, E side of Gordon Inlet, 7.4 km SW of Gordon Inlet Rd along Gairdner Rd, 34°23'S, 119°24'E, 5 Oct. 1984, S.D. Hopper 4225 (PERTH 00249181); 6 km SSE of Gracetown, 7 km NW of Margaret River, 33°55'S, 115°00'E, 9 Oct. 1984, S.D. Hopper 4296 (PERTH 00249092).

Distribution and habitat. In Western Australia, *Caladenia bicallata* subsp. *bicallata* is found in coastal woodlands and dense coastal heath between Kalbarri and Bremer Bay. (Figure 41B)

Flowering period. August to October.

Notes. This is the more common and widespread of the two subspecies of *Caladenia bicallata*, characterized by its larger dichogamous flowers.

Caladenia bicallata* subsp. *cleistogama Hopper & A.P. Br., *subsp. nov.*

A subsp. *bicallata* florum parve et cleistogamorum differt.

Typus: 1.5 miles [2.4 km] along William Bay Road from South Coast Highway, 35°01'S, 117°11'E, Western Australia, 2 October 1971, A.S. George 11110 (*holo:* PERTH 00249149).

Illustration. N. Hoffman & A. Brown, *Orchids of South-West Australia*, rev. 2nd edn with suppl., p. 416 (1998).

Flowers cleistogamous, c. 0.5 cm across when closed. *Dorsal sepal* strongly incurved with a horizontal apex, 1.2–1.5 cm x 1.5–2 mm. *Lateral sepals* erect and curved forward with a horizontal apex, 1.2–1.5 cm x 1.5–2.5 mm. *Petals* erect and curved forward with a horizontal apex, 1.2–1.5 cm x 1.5–2 mm. *Labellum* articulate on a claw c. 0.5 mm wide; lamina 5–6 x 4–5 mm. *Lamina calli* in 10 pairs. *Column* 2.5–3 mm wide, narrowly winged. (Figure 42A–G)

Distribution and habitat. In Western Australia, confined to coastal areas east of Esperance with an outlier near William Bay. The subspecies has also been recorded from coastal South Australia. (Figure 43B)

Flowering period. August to September.

Notes. Only represented by the type specimen (Priority One) but also from populations in the Esperance area. This subspecies is poorly known and inconspicuous, being the only cleistogamous *Caladenia* recorded for Western Australia. Its flowers are smaller than those of the nominate subspecies, and the column more narrowly winged.

Etymology. Named from the Latin *cleistogamus* (fertilized within the unopened flower), alluding to the usually closed flowers of the subspecies.

Caladenia brevisura Hopper & A.P. Br., *sp. nov.*

A *Caladenia douchiae* O. Sarg. sepalis lateralibus abbreviatis 1.5–2.2 cm longis et 3–4 mm latis cum clavis atro-brunneis 1–2 mm longis differt.

Typus: West Point Rd crossing, Oldfield River, c. 45.5 km east of Ravensthorpe, 33°33'S, 120°33'E, Western Australia, 24 September 1988, S.D. Hopper 6816 (*holo:* PERTH 01152181; *iso:* AD).

Illustrations. M. Hodgson & R. Paine, *Field guide to Australian Orchids*, p. 78 [as *Caladenia roei*] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 135 (1992) and rev. 2nd edn with suppl., p. 135 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 6–12 cm x 4–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–25 cm tall. *Flowers* 1(2), c. 1–2 cm across, predominantly pinkish maroon to pale yellow-green with variable suffusions, lines and spots of dull

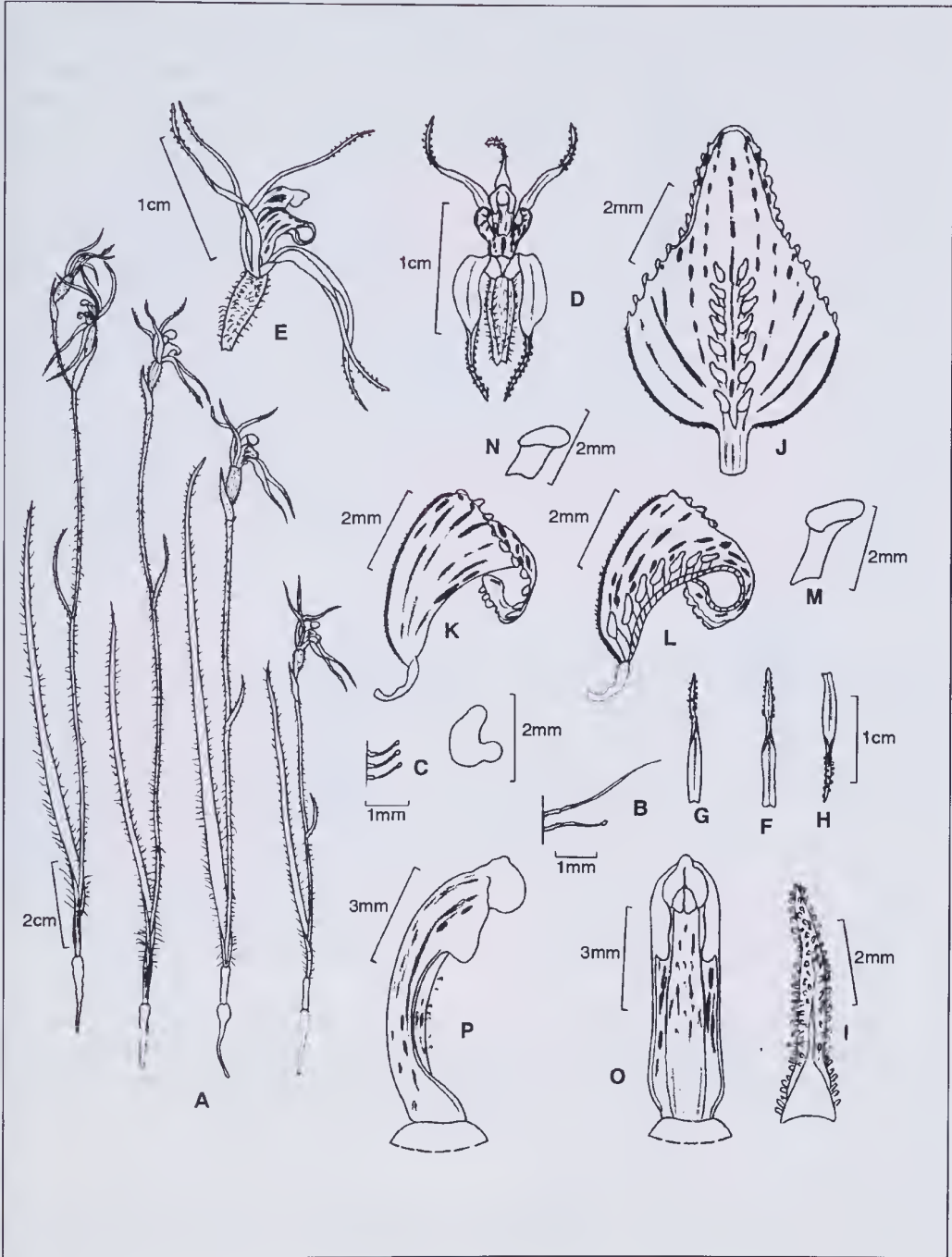


Figure 42. *Caladenia bicallata* subsp. *cleistogama* from near Pink Lake, Esperance, D. Voigt s.n. A - plants; B - hairs from lower scape; C - hairs from upper scape; D - flower from front; E - flower from side; F - dorsal sepal from front; G - lateral sepal from front; H - petal from front; I - sepal apex; J - flattened labellum from above; K - labellum from side; L - longitudinally sectioned labellum from side; M, N - labellum lamina calli; O - column from front; P - column from side; Q - pollinia. Drawn by D.L. Jones.

maroon; floral odour absent. *Sepals and petals* stiffly held, linear in basal 2/3; osmophore shortly cylindrical, tumescent, absent or 1–2 mm long on dorsal sepal, 1–3 mm long on lateral sepals, absent from petals, pink or fawn to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect to slightly recurved, 1.2–2.0 cm x 1.5–2 mm, linear to slightly tapering in basal 2/3, narrowing to an acute apex or osmophore. *Lateral sepals* straight, spreading obliquely downwards, 1.5–2.2 cm x 3–4 mm, basal 2/3 narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to a filamentous apical third. *Petals* thrust sharply downward (sometimes obliquely), linear to somewhat tapering, 1.3–1.6 cm x 1.5–2 mm, narrowing to an acute often recurved apex. *Labellum* 3-lobed with a tiny apical midlobe, prominently 2-coloured, yellowish-green to pinkish maroon with red to dark brown radiating stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 2 mm wide; lamina laterally oval with a small obtuse apex in outline when flattened, 9–11 x 10–14 mm, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal terminating in the last 2–3 mm in a sharply recurved apex, margins at widest point scarcely curved upwards at first and then slightly descending; lateral lobes erect to horizontal with entire margins; midlobe margins entire. *Lamina calli* aggregated in a dense central band to 2 mm wide extending at least 2/3 the length of the labellum and stopping short of the dark maroon apex, dark purplish maroon with white base, erect, linear, capitate with a shiny globular head, the longest c. 2 mm tall, slightly decrescent towards apex. *Column* 10–13 x 6–8 mm, broadly winged, greenish-yellow with maroon blotches. *Anther* c. 2 x 2 mm, yellow-green. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2–2.5 mm wide, yellow-green. *Capsule* not seen. (Figure 43)

Selected specimens examined. WESTERN AUSTRALIA: Grass Patch, 7 Sep. 1979, A. Brown s.n. (PERTH 00238686); 4.7 km due SE of Kau Rocks, 1 km NW of Mt Ney Rd on Kau Rocks Rd, 33°27'S, 122°21'E, 5 Sep. 1984, M.A. Burgman & C. Layman MAB 3496 (PERTH 00237760); Fitzgerald River National Park, 500 m N of Hamersley River Bridge on Telegraph Rd, 33°23'S, 119°52'E, 3 Oct. 1984, S.D. Hopper 4182 (CBG, PERTH 00240613); Wittenoom Hills, 47 km NE of Esperance, 33°28'S, 122°08'E, 8 Oct. 1985, S.D. Hopper 4684 (PERTH 00844241); N side of South Coast Highway between Jerramungup and Ravensthorpe, 0.8 km E of West River Bridge; c. 35 km SW of Ravensthorpe, 33°41'S, 119°41'E, 24 Sep. 1988, S.D. Hopper 6805 (PERTH 01667491); Fitzgerald River National Park, NW of East Mt Barren on Pabelup Drive, 34°10'S, 119°25'E, 3 Oct. 90, S.D. Hopper 7873 (PERTH 1829998); 2.5 km S along the Southern Cross–Forrestiana road from the Hyden–Norseman road, W of Lake Cronin, 32°27'S, 119°45'E, 19 Sep. 1991, B. Jackson s.n. (PERTH 1828541); Scaddan Rd, E of Esperance–Norseman Highway, 16 Sep. 1988, A.J.G. Wilson 152 (PERTH 00899666).

Distribution and habitat. Occurs between the Lake Cronin–Ravensthorpe area and Israelite Bay, with scattered populations found as far north as Norseman, growing in a range of habitats from shallow soil pockets on granite outcrops, to open mallee woodlands and *Melaleuca* thickets on the margins of salt lakes. Soil ranges from deep sand, to clays and granitic loams. (Figure 41C)

Flowering period. August to October.

Etymology. Named from the Latin *brevi-* (short) and *sura* (calf of leg), alluding to the shortened tips to the sepals.

Notes. A scattered but often locally common species with small pale green and yellow flowers often marked with red suffusions. Its nearest allies are *Caladenia douthiae*, from which it differs in its slightly smaller flowers with short tips to the sepals, generally narrower labellum with a broader band of calli, and its more easterly distribution, and *C. incrassata*, from which it differs in its dorsal sepal

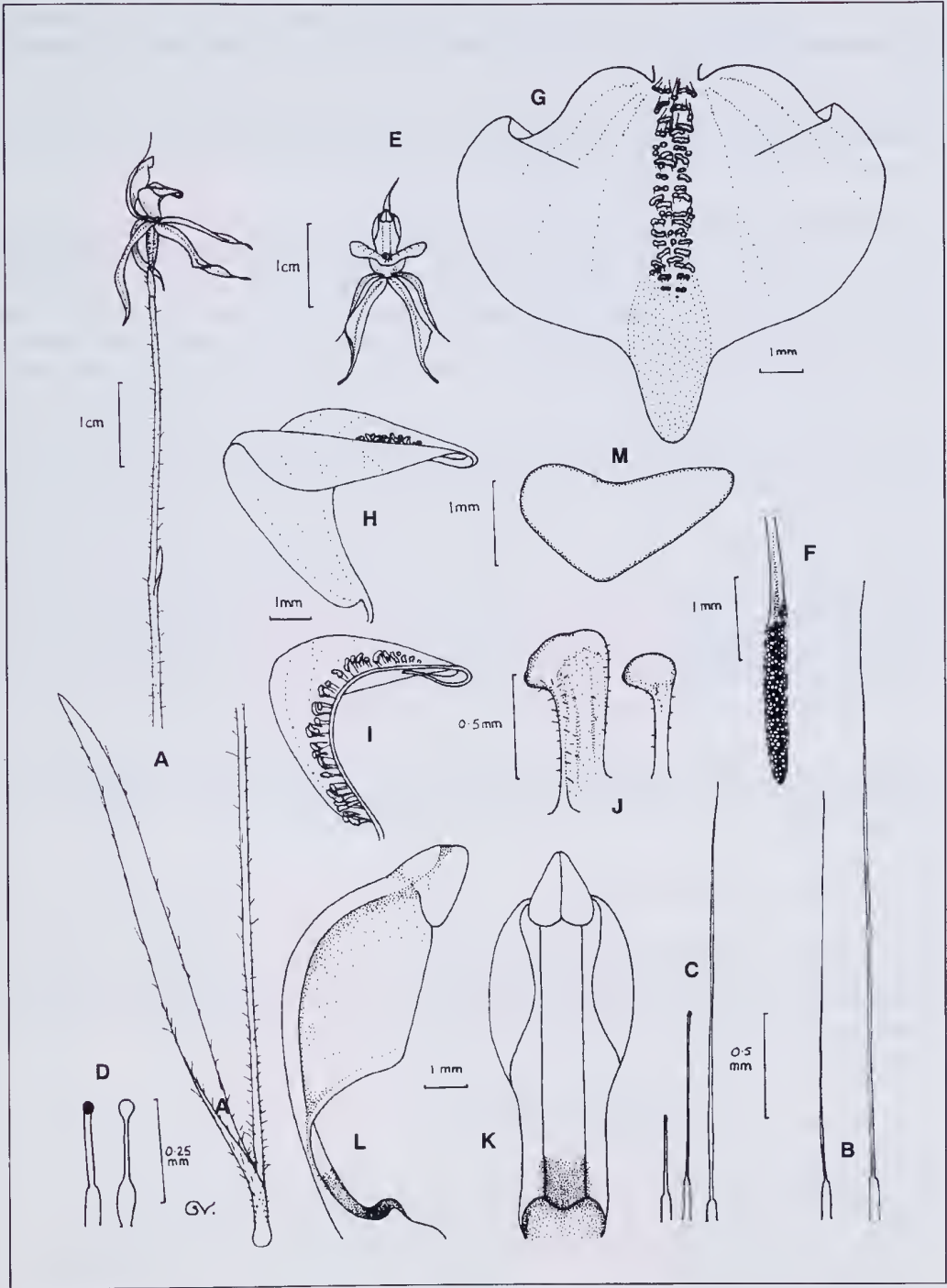


Figure 43. *Caladenia brevisura* from north-east of Ravensthorpe, S.D. Hopper 6810. A – plant; B – leaf hairs; C – stem hairs; D – ovary hairs; E – flower from front; F – sepal osmophore; G – labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J – calli; K – column from front; L – column from side; M – pollinia. Drawn by C. Vasilu.

rarely with a small osmophore, its lateral sepals with smaller clubs, and its more south-easterly distribution. Occasional hybrids occur in the Ravensthorpe area where the distributions of *C. brevisura* and *C. douthiae* overlap.

Caladenia bryceana R.S. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 54: 46 (1930). Type: Gnowangerup, Western Australia, 3 September 1914, B. MacIntyre s.n. (holo: AD).

Plant solitary or in loose clumps. *Leaf* erect to horizontal, linear, 4–8 cm x 5–12 mm, pale green. *Scapes* 3–10 cm tall. *Flowers* 1(2), c. 1–2 cm across, pale green, sometimes with variable suffusions, lines and spots of dull maroon to pink; floral odour absent. *Sepals and petals* stiffly held, lacking an osmophore, apex obtuse. *Dorsal sepal* erect to slightly incurved, linear, 0.8–1.1 cm x 1.5–2 mm. *Lateral sepals* straight, spreading obliquely downwards and curving inwards to meet distally, broadly lunate, 0.7–1.0 cm x 2–3 mm. *Petals* thrust sharply downward or spreading and curved forward, linear, 0.9–1.1 cm x 1.0–1.5 mm. *Labellum* 3-lobed with a tiny apical midlobe, prominently 2-coloured, pale green, lacking stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina cordate with a small obtuse apex in outline when flattened, 5–6 x 5–6 mm, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal to downcurved terminating in the last 1 mm in a sharply recurved apex, margins at widest point scarcely curved upwards at first and then becoming horizontal; lateral lobes erect to horizontal with entire margins; midlobe margins entire. *Lamina calli* aggregated in a dense central continuous or discontinuous band extending at least 3/4 the length of the labellum and stopping short of the dark maroon apex, erect, dark purplish black (rarely green or fawn) with a white base, linear, capitate with a shiny broadly to narrowly globular head, the longest c. 1 mm tall, slightly decrescent towards apex. *Column* 7–10 x 5–7 mm, broadly winged, greenish-yellow with maroon blotches. *Anther* c. 1.5 x 1.5 mm, yellow-green. *Pollinia* c. 1 mm long, yellow. *Stigma* c. 2 mm wide, yellow-green. *Capsule* not seen.

Distribution. A rare species confined to two disjunct areas of south-west Western Australia, the northern one between Nerren Nerren Station and Horrocks and the southern one between Boyup Brook and Boxwood Hills.

Flowering period. August to October.

Notes. *Caladenia bryceana* and *C. pachychila* are the smallest-flowered species of *Caladenia* in Western Australia, and are, consequently, easy to overlook. *C. bryceana* differs from *C. roei* in its much smaller flowers, lacking glandular tips to the lateral sepals. Its labellum lamina is mostly green with a dark maroon eglandular apex, unlike the striped lamina with glandular apical margins of *C. pachychila*.

C. bryceana has two widely disjunct subspecies.

Key to subspecies of *Caladenia bryceana*

1. Calli in a continuous band (always present in the middle of the labellum lamina), apex broadly globular subsp. **bryceana**
- 1: Calli in a discontinuous band (usually absent from the middle of the labellum lamina), apex narrowly globular subsp. **cracens**

Caladenia bryceana R.S. Rogers subsp. **bryceana**

Illustrations. R. Erickson, *Orchids of the West*, 2nd edn, plate 28 No. 6 (1965); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 18 A1, A2 (1984); D. Jones, *Native Orchids of Australia*, p. 109 (1988); S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, *Western Australia's Endangered Flora*, plate 46, (1990); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 144 (1984), 2nd edn, p. 138 (1992) and rev. 2nd edn with suppl., p. 138 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 173 (1998).

Leaf 4–6 cm x 5–7 mm. *Lamina calli* in a continuous band (always present in the middle of labellum lamina), capitate with a broadly globular head. (Figure 44A–G)

Selected specimens examined. WESTERN AUSTRALIA: Boxwood Hill area, 5 Sep. 1979, A. Brown s.n. (PERTH 00253901); near Dinninup, 26 Sep. 1984, E. Chapman s.n. (PERTH 00404276); SSW of Moodiarrup, 11 Sep. 1985, S.D. Hopper 4538 (PERTH 00873616); Stirling Range, Sep. 1962, R. Oliver s.n. (PERTH 00253898).

Distribution and habitat. Found between Boxwood Hills and Boyup Brook in open Wandoo woodland and mallee shrublands, often adjacent to watercourses. Soils are either sandy-clay or loam. (Figure 41D)

Flowering period. Late August to October.

Notes. A rare subspecies (Declared Rare) known from a few scattered populations that are usually small and on land under threat. It is distinguished by its continuous band of broadly capitate calli, its somewhat shorter narrower leaves, its southerly distribution, and its marginally later flowering period.

***Caladenia bryceana* subsp. *cracens* Hopper & A.P. Br., subsp. nov.**

A subsp. *bryceana* callis angusto-globularibus purpureo-hinnuleis ex medio labelli laminae saepe deficientibus et folio maiore 8 cm longum ey 6–12 mm latum differt.

Typus: south-west of Nerren Nerren homestead, Western Australia, 22 August 1983, S.D. Hopper 3268 (*holo:* PERTH 00333549; *iso:* CBG, PERTH).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 139 (1992) and rev. 2nd edn with suppl., p. 139 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 33 (1998).

Leaf 4–8 cm x 6–12 mm. *Lamina calli* in a discontinuous band (usually absent in the middle of labellum lamina), capitate with a narrowly globular head. (Figure 44H–K)

Selected specimens examined. WESTERN AUSTRALIA: Horrocks Beach, 18 Aug. 1987, A. Brown 644 (PERTH 00905437); State Barrier Fence, 19 Aug. 1981, A. Brown s.n. (PERTH 00929115); Murchison, 30 Aug. 1980, R. Heberle s.n. (PERTH 00261386); S of Northampton, Sep. 1960, R.M. McWhinney s.n. (PERTH 00253510).

Distribution and habitat. Found amongst low heath and herbs in shallow soil pockets on coastal limestone hills between Kalbarri and Horrocks, and in winter moist Broom Bush (*Melaleuca uncinata*) flats between Nerren Nerren Station and the Murchison River. Soil is either calcareous sand or sandy-loam. (Figure 41D)

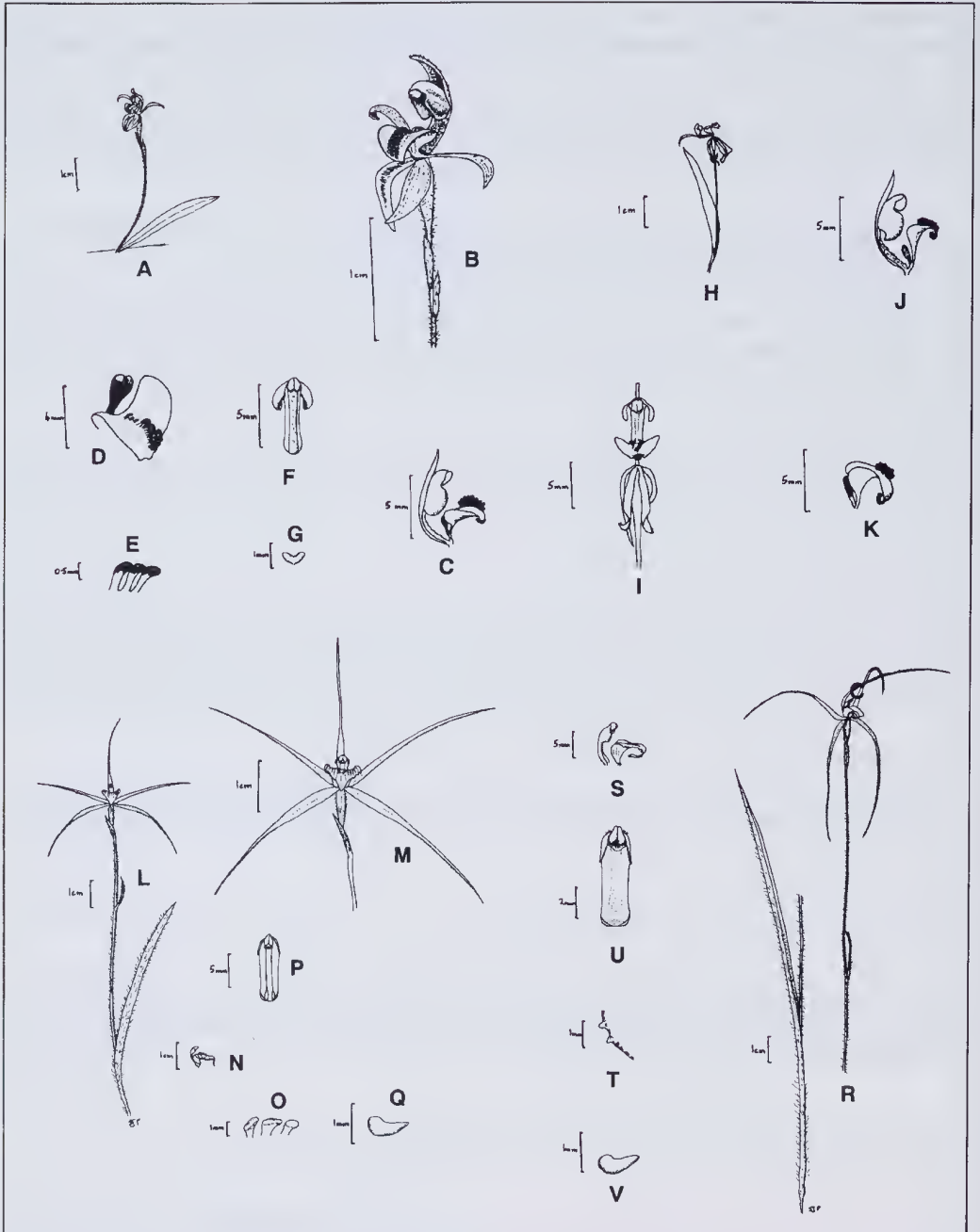


Figure 44. A-G. *Caladenia bryceana* subsp. *bryceana* from the Boyup Brook area, S.D. Hopper 4538. A - plant; B - flower; C - labellum and column from side; D - labellum and column from front; E - calli; F - column from front; G - pollinia. H-K. *C. bryceana* subsp. *cracens* from the Murchison area, A.P. Brown 644. H - plant; I - flower from front; J - labellum and column from side; K - labellum from side. L-Q. *C. caesarea* subsp. *maritima* from the Dunsborough area, S.D. Hopper 4518. L - plant; M - flower from front; N - labellum and column from front; O - calli; P - column from front; Q - pollinia. R-V. *C. caesarea* subsp. *transiens* from the Williams area, S.D. Hopper 4620. R - plant; S - labellum and column from side; T - labellum fringe; U - column from front; V - pollinia. Drawn by S.J. Patrick.

Flowering period. August to early September.

Etymology. Named from the Latin *cracens* (neat, graceful, slender), alluding to the more slender-headed calli of this subspecies.

Notes. This rare subspecies (Declared Rare) was first collected near Northampton in 1960 but has not been recollected there since. Although recorded in diverse habitats, only five widely disjunct populations have been discovered so far. However, its known distribution suggests that it may occur within Kalbarri National Park.

It would be interesting to ascertain if *Caladenia bryceana* subsp. *cracens* shares the same pollinator as subsp. *bryceana*. The difference in calli between the two subspecies may indicate that different pollinators are involved.

Caladenia caesarea (Domin) M. Clements & Hopper, *Australian Orchid Research* 1: 21 (1989). – *Caladenia filamentosa* R. Br. var. *caesarea* Domin, *J. Proc. Linn. Soc. Bot.* 41: 251 (1912). *Type:* Bridgetown to Kojonup and Slab Hut Gully, Western Australia, 1910, A. Dorrien-Smith s.n. (*lecto:* K, here chosen; *iso:* K, L, n.v.).

Plant solitary or in dense clumps. *Leaf* erect, linear, 6–18 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–35 cm tall. *Flowers* 1(2), c. 4–7 cm across, golden yellow with dark maroon to brown stripes and markings; floral odour faint, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a dark brown-maroon densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3–7.5 cm x 2–3 mm. *Lateral sepals* spreading to downcurved, 3–7.5 cm x 2–5 mm. *Petals* erect to spreading or downcurved, 2.5–6.5 cm x 2–3 mm. *Labellum* golden-yellow with thick dark maroon to brown stripes and markings to the apex, stiffly articulate on a claw 1–2 mm wide; lamina linear-rhomboidal in outline when flattened, 10–20 x 7–11 mm, obscurely 3-lobed to lacking lateral lobes, erect with entire margins in basal third, horizontal in middle third, apical third slightly downcurved (sharply recurved only in *Caladenia caesarea* subsp. *transiens*), margins at widest point moderately curved upwards and terminated by slightly descending calli, distal margins dentate (rarely entire) with widely spaced serrate yellow to yellow-maroon acute or obtuse marginal calli decrescent towards the apex. *Lamina calli* in 5–10 pairs in 2 rows extending up to half the length of the labellum, pale yellow, anvil-shaped, the longest c. 2 mm tall, somewhat decrescent distally, the top glistening and elongate-oval. *Column* c. 8–14 x 2.5–6 mm, narrowly winged, creamy yellow to yellow with red stripes and blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 2–3 x 2–3 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 1.5–2 mm wide. *Capsule* not seen.

Distribution and habitat. Sporadically distributed in the western and southern wheatbelt from Williams south to Dumbleyung and Tenterden, extending west through the forest region to the Collie, Busselton and Meelup areas. Occurs in a range of habitats, from Wandoo flats to sheoak (*Allocasuarina*) groves, Jam low woodlands and heath near granite outcrops.

Flowering period. August to November.

Notes. Lectotypification of *Caladenia caesarea* is required because the type sheet has two taxa on it. There are three specimens, two of *C. caesarea* subsp. *caesarea*, and one of *C. polychroma*. The lectotype

is the left-hand specimen. It bears a determinavit by K. Domin as "*Caladenia filamentosa* R. Br. var. *luteonigra* m". The syntype of *C. caesarea* on the right-hand side has a determinavit by K. Domin as "*Caladenia filamentosa* R. Br.", and the middle specimen of a red morph of *C. polychroma* also has a determinavit by K. Domin as "*Caladenia filamentosa* R. Br.". Thus, only the left-hand specimen is assigned a varietal epithet by Domin (as var. *luteonigra* ms., which he changed to var. *caesarea* in publication), and this specimen matches the protologue. It is the most appropriate lectotype.

The yellow colouration and glistening calli of *Caladenia caesarea* suggest an affinity with *C. elegans*, *C. luteola* and *C. xantha*. *C. caesarea* differs from these three species in its golden yellow colouration with darker maroon to brown stripes and markings.

Domin (1912) and many subsequent workers (e.g. George 1971a) regarded *caesarea* as merely a variety of *Caladenia filamentosa*. Clements & Hopper (in Clements 1989) raised the taxon to full species status, and provided a brief diagnosis as follows: "differs from other taxa in the *C. filamentosa* complex in its perianth which is yellow with prominent dark brown stripes, the labellum protruding with the apex often only partially recurved, and the labellum margins sparsely serrate and usually downcurved". This diagnosis we now know applies to only two of the three subspecies recognized below.

Key to subspecies of *Caladenia caesarea*

1. Labellum apex protruding, often only partially recurved
 2. Lateral sepals 4.5–8 cm long and 3–4.5 mm wide. Petals 4.5–6.5 cm long. Labellum 12–16 mm long and 9–11 mm wide. Wet flats between Tenterden and Busselton subsp. **caesarea**
 - 2: Lateral sepals 2.3–6 cm long and 2–2.5 mm wide. Petals 2.5–5 cm long. Labellum 10–15 mm long and 6–9 mm wide. Coastal granites near Dunsborough subsp. **maritima**
- 1: Labellum apex evenly recurved subsp. **transiens**

Caladenia caesarea (Domin) M. Clements & Hopper subsp. **caesarea**

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia - cultivation and natural history*, colour plate 1 opposite p. 60 [as *C. filamentosa* var. *caesarea*] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 82 [as *Caladenia filamentosa* var. *caesarea*] (1984), 2nd edn, p. 59 (1992) and rev. 2nd edn with suppl., p. 59 (1998).

Flowers c. 6–7 cm across. *Dorsal sepal* 4–7.5 cm x 2–3 mm. *Lateral sepals* 4.5–7.5 cm x 3–5 mm. *Petals* 4.5–6.5 cm x 2–2.5 mm. *Labellum lamina* 12–16 x 9–11 mm; apical third slightly downcurved. (Figure 38M–Q)

Selected specimens examined. WESTERN AUSTRALIA: 26.9 km S of Jingalup on Kojonup–Frankland road, 34°09'S, 117°01'E, 17 Oct. 1985, A. Brown 259 (PERTH 00905410); Boyup Brook, 12 Oct. 1975, E. Chapman s.n. (PERTH 00251062); E side of Frankland River, Muir Highway, 34°29'S, 116°54'E, 2 Nov. 1977, A.S. George 15015 (PERTH 00251070); Pindalup, Oct. 1926, B.T. Goadby 3497 (PERTH 00251011); 2 km SE of Tenterden Siding, Nature Reserve, 9 km SSE of Cranbrook, 34°22'S, 117°34'E, 7 Oct. 1983, S.D. Hopper 3497 (CBG, PERTH 00251097); Tenterden Nature Reserve, E of Tenterden, 34°22'S, 117°33'E, 15 Oct. 1986, S.D. Hopper 5715 (PERTH 01669613); near pole dump opposite radio transmitter, 2–3 miles [3–5 km] W of Wagin, 4 Nov. 1973,

W.P. Stoutamire s.n. (PERTH 00251046).

Distribution and habitat. Ranges from Wagin and Tenterden west to Busselton, favouring Wandoo flats. (Figure 45A)

Flowering period. Late September to November.

Notes. This is the most widespread and best known subspecies of *Caladenia caesarea*. It shares with subsp. *maritima* a prominently coloured protruding labellum, but is larger in all respects and has a more inland distribution. It differs from subsp. *transiens* in its larger flowers with the labellum apex protruding rather than evenly recurved. *Caladenia caesarea* subsp. *caesarea* also flowers later than either of the other two subspecies.

Caladenia caesarea subsp. *caesarea* hybridizes with *C. polychroma* near Tenterden, and with *C. luteola* west of Woodanilling.

***Caladenia caesarea* subsp. *maritima* Hopper & A.P. Br., subsp. nov.**

A subsp. *caesarea* floribus minoribus, in petris granitibus orae habitantibus et florenti plus mature differt.

Typus: Dunsborough, Western Australia, 9 September 1985, *S.D. Hopper* 4518 (*holo:* PERTH 00911151; *iso:* CBG).

Illustrations. S. Hopper, S. van Leeuwen, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 51 [as *Caladenia* sp. (Cape Naturaliste)] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 58 (1992) and rev. 2nd edn with suppl., p. 58 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 157 (1998).

Flowers c. 4–5 cm across. **Dorsal sepal** 2.5–6 cm x 2–2.5 mm. **Lateral sepals** 2.5–6 cm x 2–2.5 mm. **Petals** 2.5–5 cm x 2–3 mm. **Labellum lamina** 10–15 x 6–9 mm; apical third slightly downcurved. (Figure 44L–Q)

Selected specimens examined. WESTERN AUSTRALIA: Dunsborough area, 9 Sep. 1985, *S.D. Hopper* 4520 (CBG, PERTH 00911178); Cape Naturaliste area, 12 Aug. 1986, *G.J. Keighery* 8292 (PERTH 00792276); near Cape Naturaliste, 2 Sep. 1972, *B.R. Maslin* & *R. Wilkie* BRM 2804 (PERTH 00251054).

Distribution and habitat. Confined to coastal granite areas near Cape Naturaliste over a geographical range of just 5 km, with a northern outlier in Tuart forest near Ludlow. In the Cape Naturaliste area, it is usually found amongst low heath and herbs in shallow soil pockets on sheet granite, and occasionally may also be found under dense shrub thickets of *Calothamnus graniticus* in deeper soils away from granite. At Ludlow it grows in open forest in an open herbaceous understorey. (Figure 45A)

Flowering period. August to September.

Etymology. Named from the Latin *maritimus* (growing by the sea), alluding to the coastal habitat occupied by the subspecies.

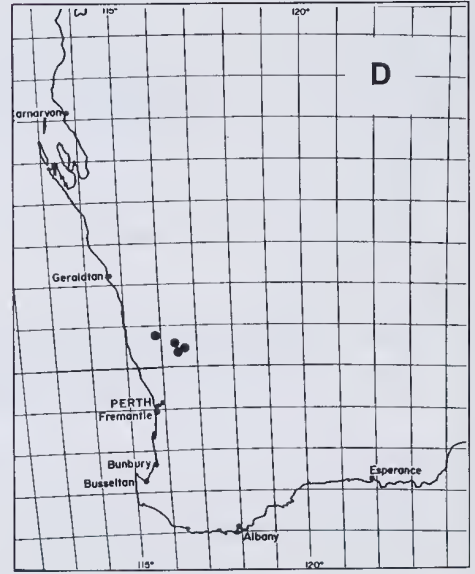
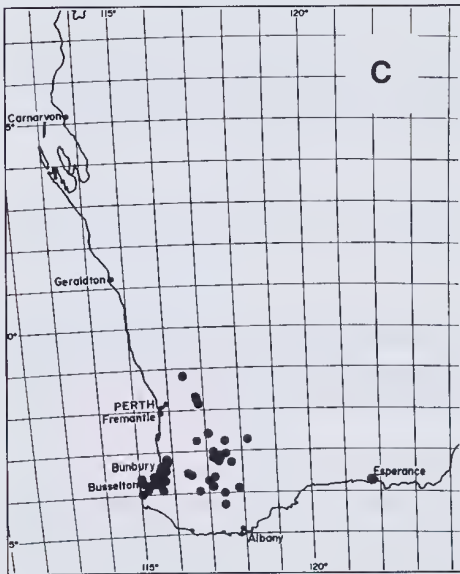
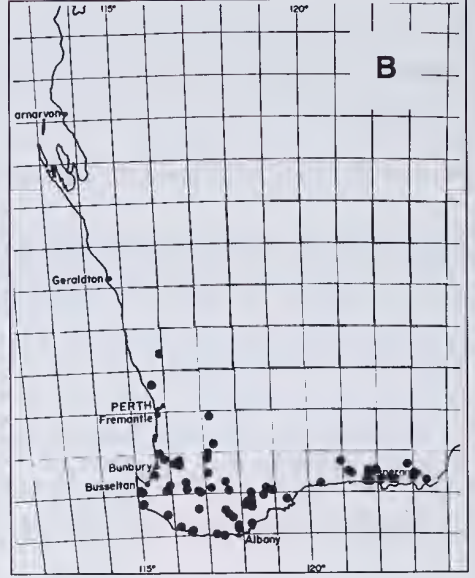
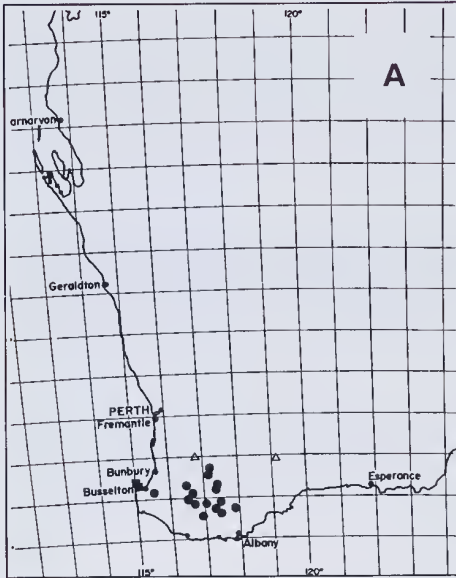


Figure 45. Distribution maps. A – *Caladenia caesarea* subsp. *caesarea* ●, *C. caesarea* subsp. *maritima* ■ and *C. caesarea* subsp. *transiens* △; B – *C. cairnsiana*; C – *C. chapmanii*; D – *C. cristata*.

Notes. A rare subspecies of very restricted distribution (Declared Rare) in the Cape Naturaliste and Ludlow areas. It differs from *Caladenia caesarea* subsp. *caesarea* in its smaller flowers and its earlier flowering period, while from *C. caesarea* subsp. *transiens* it differs in its protruding labellum apex and near-coastal habitat.

***Caladenia caesarea* subsp. *transiens* Hopper & A.P. Br., subsp. nov.**

A subsp. *caesarea* floribus minoribus, et labello recurvato manifeste ad apicem differt.

Typus: 19.6 km south of Williams directly opposite the Dardadine turnoff on the Albany Highway, 33°11'S, 116°58'E, Western Australia, 17 September 1985, S.D. Hopper 4620 (*holo:* PERTH 00911186).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 57 (1992) and rev. 2nd edn with suppl., p. 57 (1998).

Flowers c. 5–6 cm across. *Dorsal sepal* 3.5–4 cm x 1.5–2 mm. *Lateral sepals* 4–4.5 cm x 1.5–2 mm. *Petals* 3.5–4 cm x 1.5–2 mm. *Labellum lamina* 12–13 x 7–7.5 mm; apical third evenly recurved. (Figure 44R–V)

Selected specimen examined. WESTERN AUSTRALIA: 14 km S of Newdegate on Lockhart Rd, 33°14'S, 119°02'E, 13 Sep. 1985, S.D. Hopper 4566 (PERTH 00910740).

Distribution and habitat. Known from disjunct locations—a small area south of Williams where it grows under dense Rock Oak thickets amongst scattered low shrubs and dense herbs in sandy-clay soil, and south of Newdegate on shallow soils overlying granite in open mallee of *Eucalyptus loxophleba* subsp. *gratae* over Tamma (*Allocasuarina campestris*) heath and *Borya constricta* herbfield. It has also been recorded from the Dumbleyung area (R. Heberle pers. comm.). (Figure 45A)

Flowering period. September to October.

Etymology. Named from the Latin *transiens* (passing over into, being changed into), alluding to the labellum of this subspecies which has the yellow colouration and prominent radiating stripes of *C. caesarea* but the curled apex of the remainder of the *C. filamentosa* complex.

Notes. *Caladenia caesarea* subsp. *transiens* is a poorly known but apparently rare subspecies (Priority Two) which appears to be restricted to the Williams–Darken area and eastwards near Newdegate. It differs from the other subspecies of *C. caesarea* in its labellum prominently curled downward at the apex.

***Caladenia cairnsiana* F. Muell., *Fragm.* 7: 31 (1869) Type:** north of Stirling Range, Western Australia, F. Mueller s.n. (*holo:* MEL; *iso:* K).

Illustrations. E. Pelloe, West Australian Orchids, frontispiece colour plate No. 5 (1930); W. Blackall & B. Grieve, How to know Western Australian Wildflowers, Part 1, p. 95 (1954); R. Erickson, Orchids of the West, 2nd edn, plate 28, (Figure 8 (1965); W. Nicholls, Orchids of Australia, plate 235 (1969); D. Clyne, Australian Ground Orchids, p. 41 (1970); M. Pocock, Ground Orchids of Australia, photo 10 (1972); K.W. Dixon, B.J. Buirchell & M.T. Collins (eds) Orchids of Western Australia, plate opposite page 56 (1989); A.S. George & H.E. Foote, Orchids of Western Australia, p. 18 bottom right photo

(undated); R. Erickson, A. George, N. Marchant & M. Morcombe, *Flowers and Plants of Western Australia*, 1st edn, p. 68, plate 185 (1973); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 13A (1984); D. Jones, *Native Orchids of Australia*, p. 109, top right (1988); M. Hodgson & R. Paine, *Field guide to Australian Orchids*, p. 59 left (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 138 (1984), 2nd edn, p. 130 (1992) and rev. 2nd edn with suppl., p. 130 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 6–20 cm x 3–6 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1(2), c. 1 cm across, creamy yellow with dark maroon stripes and markings; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate, shortly constricted at apex, sparsely glandular adaxially, lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 1.5–2.0 cm x 2–3 mm. *Lateral sepals* thrust downwards appressed to ovary with apices splayed slightly outwards, 1.2–1.5 cm x 1.5–3 mm. *Petals* thrust downwards appressed to ovary, 1.2–1.5 cm x 1.5–2 mm. *Labellum* creamy-yellow with thick dark maroon radiating stripes, stiffly articulate and held obliquely upwards above 45° on a claw 1–2 mm wide; lamina rhomboidal with rounded entire margins in outline when flattened, 10–16 x 9–12 mm, obscurely 3-lobed, erect in basal third, slightly to prominently ascending with downcurved margins in apical 2/3, terminating in a red-maroon V-shaped apical callus c. 2 mm long, margins at widest point moderately curved upwards then becoming slightly descending. *Lamina calli* in 4–16 pairs in 2 rows extending up to 2/3 the length of the labellum, capitate with cream base and dark maroon irregularly swollen apex, the longest c. 2 mm tall, about the same size throughout, top shiny. *Column* c. 10–14 x 6–8 mm, broadly winged, pale maroon. *Anther* c. 2–3 x 2–3 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 46A–D)

Selected specimens examined. WESTERN AUSTRALIA: Nightwell Rd, 12.5 km ESE of Chester Pass Rd, 34°13'S, 118°22'E, 14 Oct. 1986, A. Brown 466 (PERTH 00928631); Mowen Rd, 33°25'S, 115°30'E, 15 Oct. 1985, A. Brown s.n. (PERTH 00843709); Reserve 2218, NW of Tenterden, 34°21'S, 117°33'E, 27 Sep. 1977, A.S. George 14953 (PERTH 00252530); Boyatup Hill, N side of Esperance, Cape Arid National Park–Israelite Bay highway, 33°44'S, 123°02'E, 7 Oct. 1982, S.D. Hopper 2517 (PERTH 00251585); 0.7 km W of Muja Power Station entrance (SE of Collie), 33°27'S, 116°18'E, 19 Oct. 1982, S.D. Hopper 2671 (PERTH 00252476); Leeuwin–Naturaliste National Park, 8 km NW of Augusta, Jewel Cave turnoff, Caves Rd, 34°16'S, 115°06'E, 4 Oct. 1983, S.D. Hopper 3436 (PERTH 00333972); William Bay National Park, 3.5 km W of Ocean Beach Road on Mooney Valley Rd, 8 km SSW of Denmark, 35°01'S, 117°21'E, 7 Oct. 1984, S.D. Hopper 4254 (PERTH 00252468); 50 km S of Mandurah on the Old Coast Rd, 2 km N of Preston Beach, 32°54'S, 115°13'E, 9 Sep. 1985, S.D. Hopper 4499 (PERTH 00843733).

Distribution and habitat. Widespread between Watheroo National Park and Esperance in a variety of habitats ranging from open mallee woodland to dense Jarrah forest, Peppermint woodland and coastal heath. Plants do not appear to favour any particular soil type and can be found in deep sandy soils, clay loams and lateritic loams. (Figure 45B)

Flowering period. August to November.

Notes. *Caladenia cairnsiana* was previously considered to be a single variable species widespread in inland, coastal and lower south-west Western Australia. The inland taxon is, however, taxonomically distinct and is described herein as *C. pachychila*. *C. cairnsiana* differs from *C. pachychila* in its taller scapes, its larger darker-coloured flowers with petals and lateral sepals clasping the ovary, and its wider

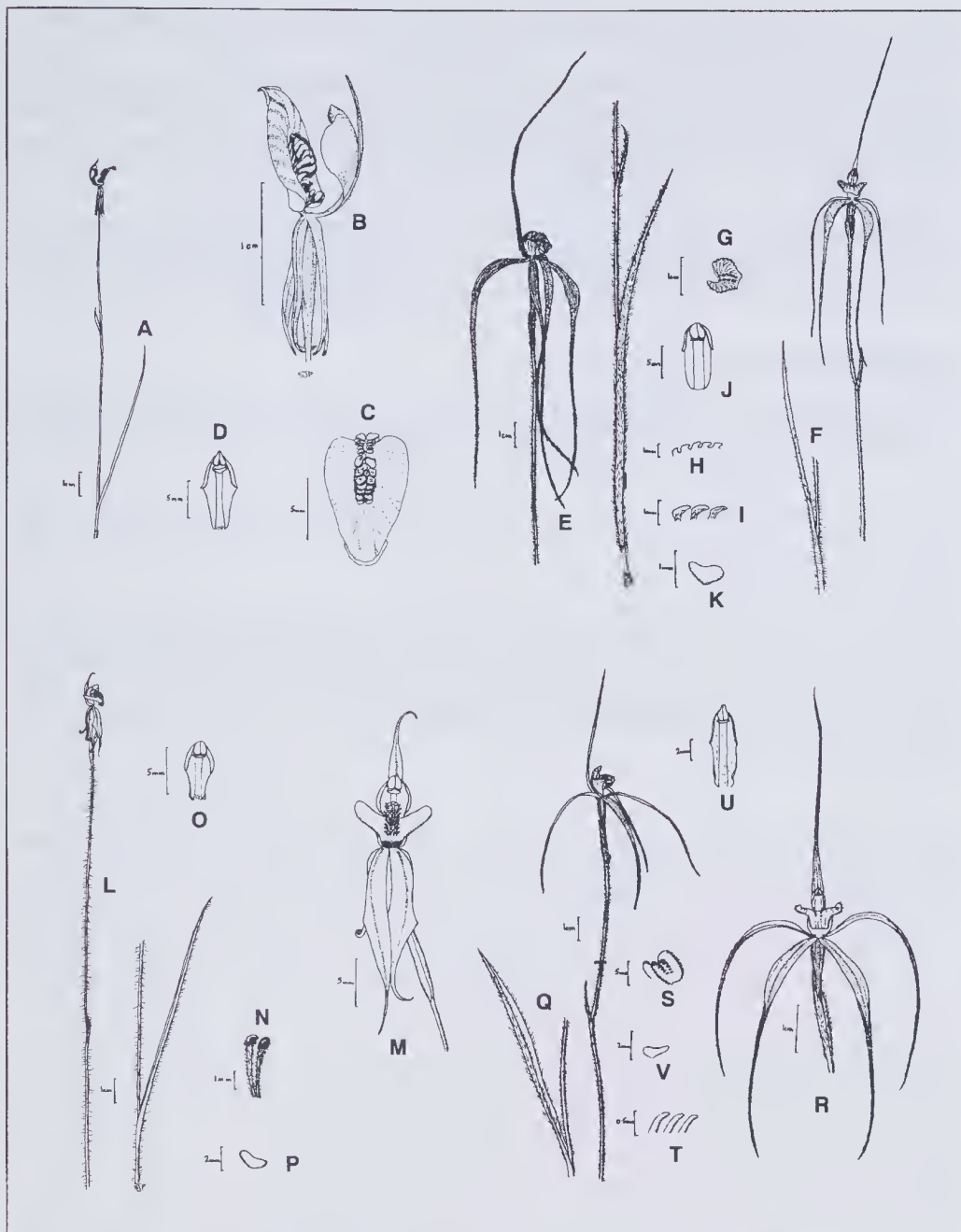


Figure 46. A–D. *Caladenia cairnsiana* from Nannup, S.D. Hopper 4525. A – plant; B – flower from side; C – labellum from above; D – column from front. E–K. *C. chapmanii* from the Williams and Dunsborough areas, A.P. Brown s.n. E – plant from Williams area; F – plant from Dunsborough area; G – labellum from above; H – labellum fringe; I – calli; J – column from front; K – pollinia. L–P. *C. cristata* from Miling, A.P. Brown & S. van Leeuwen 414. L – plant; M – flower from front; N – calli; O – column from front; P – pollinia. Q–V. *C. denticulata* from the Arrowsmith area, A.P. Brown s.n. Q – plant; R – flower from front; S – labellum; T – calli; U – column from front; V – pollinia. Drawn by S.J. Patrick.

more rounded labellum held at an angle well above the horizontal, with a reduced apical callus.

The two species overlap in distribution only to the north of Esperance. Both are pollinated by sexually deceived male thynnid wasps, but experiments using bait flowers have confirmed that different pollinators are involved (A.P. Brown, unpublished). A cross between *Caladenia cairnsiana* and *C. filifera* produces the named hybrid *C. x ericksoniae*.

Caladenia cairnsiana and *C. pachychila* appear to have their nearest relatives in eastern Australia, sharing several characters with species such as *C. cardiochila* Tate and *C. tessellata* Fitzg. A more distant relationship may be with *C. discoidea* from south-western Australia.

***Caladenia chapmanii* Hopper & A.P. Br., sp. nov.**

A speciebus aliis *Caladenia filamentosa* R.Br. affinibus floribus majoribus et petalis sepalisque saepe distincte marroninis vel mixtis flavidis marroninis differt.

Typus: 26 km east-north-east of Wilga Siding, 25 km north-north-east of Boyup Brook, 33°39'S, 116°30'E, Western Australia, 6 October 1983, S.D. Hopper 3474 (*holo*: PERTH 00291331; *iso*: AD, CBG, K, MEL, NSW, PERTH 00291323).

Illustrations. W. Nicholls, Orchids of Australia, plate 258a [as *Caladenia filamentosa* (large-flowered specimen from Western Australia)] (1969); K.W. Dixon, B.J. Buirchell & M.T. Collins (eds) Orchids of Western Australia, plate b 2 opposite page 60 [as Tambellup Orchid (*Caladenia* species)] (1989); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 42 (1992) and rev. 2nd edn with suppl., p. 42 (1998).

Plant solitary or in loose to dense clumps. *Leaferect*, linear, 15–20 cm x 2–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–45 cm tall. *Flowers* 1–4, c. 6–12 cm across, rich maroon or yellow (rarely cream) with suffusions of maroon; floral odour faint, like burning metal. *Sepals and petals* lax, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a dark maroon densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly to prominently incurved, 7.5–14 cm x 3–5 mm. *Lateral sepals* spreading downward, becoming pendulous, 7.5–14 cm x 3–6 mm. *Petals* spreading near base, then abruptly downcurved and pendulous, 5.5–13 cm x 2–4 mm. *Labellum* with thick dark maroon radiating lines on a creamy-yellow background, stiffly articulate on a claw c. 2 mm wide; lamina rhomboidal in outline when flattened, 14–22 x 12–15 mm, obscurely to prominently 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate with white-tipped broad truncate marginal calli decrescent towards the apex. *Lamina calli* in 7–18 pairs in 2 rows extending at least half the length of the labellum, cream with red suffusions, narrowly anvil-shaped, the longest c. 2 mm tall, decrescent distally. *Column* 10–16 x 6–8 mm, narrowly winged, opaque creamy-yellow with a maroon tinge, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 3–4 x 3–4 mm, yellow or greenish-yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3–4 mm wide. *Capsule* not seen. (Figure 46E–K)

Selected specimens examined. WESTERN AUSTRALIA: 26 km ENE of Wilga, 33°39'S, 116°30'E, 2 Oct. 1984, E. Chapman s.n. a,b,d,e, (AD, CANB, K, MEL, PERTH 00255912); 2 km NW of Dunsborough on Cape Naturaliste Rd, 9 km SE of Cape Naturaliste, 33°35'S, 115°05'E, 5 Oct. 1983,

S.D. Hopper 3451 (CBG, PERTH 00260193); 12 km NNE of Chowrup Mill, 18 km SSE of Kulikup Siding, 33°59'S, 116°48'E, 6 Oct. 1983, *S.D. Hopper* 3485 (PERTH 00260185); Jilakin Rock, 14 km W of Kulin, 20 km SSE of Kondinin, 32°40'S, 118°20'E, 7 Sep. 1984, *S.D. Hopper* 4110 (AD, CBG, PERTH 00259756); 6.9 km ENE of York–Northam road on Lennard Rd, 31°49'S, 116°52'E, 25 Sep. 1984, *S.D. Hopper* 4166 (PERTH 00260169); 2 km NE of Capel on Railway Rd, 33°32'S, 115°35'E, 10 Oct. 1984, *S.D. Hopper* 4310 (CBG, PERTH 00259748); Bunbury bypass road, 1.8 km past South West Highway turnoff, 33°22'S, 115°40'E, 9 Sep. 1985, *S.D. Hopper* 4508 (PERTH 00910635); 500 m NW of Dunsborough shops, 33°36'S, 115°05'E, 27 Sep. 1986, *S.D. Hopper* 5562 (PERTH 00874590); Bussell Highway, c. 500 m S of Carburnup Store, 33°42'S, 115°11'E, 17 Oct. 1986, *S.D. Hopper* 5787 (PERTH 01667505); Puntapin Rock, c. 5 km ESE of Wagin, 33°16'S, 117°25'E, 14 Sep. 91, *S.D. Hopper* 8201 (PERTH 1829297).

Distribution and habitat. Occurs in scattered localities from Yallingup to Waroona in mixed Jarrah/Peppermint woodland, from Boyup Brook to Katanning and northwards to Bolgart in Wandoo woodland (often under sheoak (*Allocasuarina*) thickets), with disjunct occurrences as far inland as Jilakin Rock near Kulin. All populations occur in deep sandy soil. (Figure 45C)

Flowering period. September to October.

Etymology. Named after Mr Eric Chapman (1938–), farmer of Dinninup, who has a special interest and keen knowledge of orchids, and has shown us several new taxa he has identified in the Dinninup area, including *Caladenia chapmanii*.

Notes. *Caladenia chapmanii* is one of the largest and most spectacular of south-western orchids. Populations between Yallingup and Waroona are variable in colouration, ranging from rich maroon to yellow or cream with maroon stripes, while all populations further east are consistently dark maroon to red with prominent yellow stripes.

The species was recognized as a distinct taxon by New South Wales' Rev. H.M.R. Rupp in the 1930s or 1940s. Rupp had sorted seven collections of *Caladenia chapmanii* at the National Herbarium of New South Wales into a folder on their own and labelled them with a manuscript name as a variety of *C. filamentosa*. However, this was never published, and the species remained unnamed until now even though recognised informally by others (e.g. illustration in Nicholls 1969).

Caladenia chapmanii is readily distinguished from all other members of the *C. filamentosa* complex by its large flowers with pendulous petals and lateral sepals that are usually rich dark maroon in colour. Only *C. nobilis* attains the same size as *C. chapmanii*, but differs in its paler colouration and its more diffuse, sometimes broken radiating lines on the labellum.

Eastern populations of *Caladenia chapmanii* may attain a height of 45 cm and usually occur as scattered individuals or in small groups of two or three, whereas the western coastal populations are shorter (to 30 cm) and often form dense clumps of plants.

Caladenia cristata R.S. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 47: 337 (1923). Type: Miling, Murchison District, Western Australia, 18 September 1923, *E.S. Simpson s.n.* (holo: AD, iso: PERTH 01058711).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia – cultivation and Natural History*, rear cover (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 132 (1992) and rev. 2nd edn with suppl., p. 132 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 8–15 cm x c. 4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 18–30 cm tall. *Flowers* 1(2), c. 1–2 cm across, yellowish green with prominent dark burgundy red-maroon markings and suffusions; floral odour absent. *Sepals and petals* stiffly held, finely acuminate, lacking an osmophore. *Dorsal sepal* erect to slightly incurved, linear, 1.6–2.2 cm x 1.5–2 mm. *Lateral sepals* falcate when flattened, 1.6–2.2 cm x 3–4 mm, linear in basal 2/3 in life due to recurved outer margins, narrowing abruptly beyond point where marginal recurvature ceases, terminating in a finely acuminate apical third, spreading obliquely to vertically downwards. *Petals* splayed downwards and backwards with coiled apices, linear, 1.2–1.5 cm x 1.5–2 mm. *Labellum* prominently 3-lobed with a tiny apical midlobe, prominently to inconspicuously 2-coloured, yellowish-green to burgundy with inconspicuous burgundy radiating stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina broadly cordate with a small obtuse apex in outline when flattened, 6–8 x 7–9 mm, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal to downcurved terminating in the last 2 mm in a sharply recurved apex, margins at widest point moderately curved upwards then becoming slightly descending; lateral lobes erect to horizontal with entire margins; midlobe margins entire. *Lamina calli* aggregated in a dense central continuous band extending at least 3/4 the length of the labellum and stopping at the dark maroon apex, dark purplish black (rarely green or fawn) with a pale burgundy base, erect, linear, capitate with a shiny broadly globular head, the longest c. 2 mm tall. *Column* 7–8 x 5–6 mm, broadly winged, greenish-yellow with burgundy suffusions. *Anther* c. 2 x 2 mm, yellow-green. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide, yellow-green. *Capsule* not seen. (Figure 46L–P)

Selected specimens examined. WESTERN AUSTRALIA: S side of junction of Miling West Rd and Watheroo–Miling road, 1.5 km W of Miling, 30°30'S, 116°21'E, 20 Sep. 86, A.P. Brown & S. van Leeuwen 414 (PERTH 03314014); 400 m N of Whitewell Rd on S side of new fence, 2.7 km S of Ballidu–Bindi Bindi road, 15 Sep. 90, M. Collins s.n. (PERTH 1170023).

Distribution and habitat. Known from scattered populations between Pithara and Coorow, growing on slight rises above winter-wet, sometimes saline flats. Associated vegetation is often York Gum low woodlands with *Melaleuca cardiophylla*, *M. uncinata* shrub thickets, with sandy-loam soils. (Figure 45D)

Flowering period. September to October.

Notes. Following its initial discovery near Pithara in 1923, this elusive species was not seen again until 1986, when members of the Western Australian Native Orchid Study and Conservation Group found it growing on slight rises above saline flats west of Miling. Some nine years prior to this (1977), an orchid closely resembling *Caladenia cristata* was discovered on private farmland near Salmon Gums. At the time it was thought to be typical *C. cristata*, but it is now known to be a new species described herein as *C. voigtii*. The Australian Orchid Foundation paid for fencing to protect the first site where *C. voigtii* was collected, and the area was named “Cristata Compound”.

Caladenia cristata differs from *C. voigtii* in its slightly smaller more darkly marked flowers, its cordate labellum with narrow globular tipped calli that are free to the base; and its more northerly range of distribution.

Caladenia cristata was thought to be Critically Endangered following its rediscovery in 1986, and was declared as Rare Flora for some years (Hopper *et al.* 1990). However, surveys in 1991 established the occurrence of large numbers in a localized area on nature reserves near Watheroo, and, consequently, *C. cristata* was removed from the schedule of declared Rare Flora in 1993 but is still being monitored because of the threat of rising salinity posed to most populations.

Caladenia denticulata Lindl. in *Edward's Bot. Reg.* 1–23: Swan River Append. lii (1840). – *Caladenia filamentosa* var. *denticulata* (Lindl.) H.G. Reichb., *Beitr. Syst. Pflanzenk.* 66 (1871). Type: Swan River, [Western Australia], 1839, *J. Drummond s.n.* (lecto: K–L, *fide* George (1971: 171); *isolecto*: BM!, G!).

Caladenia filamentosa var. *pallens* Benth., *Fl. Austral.* 6: 381 (1873) *p. p. syn. nov.* Type: Swan River, *W. Mylne s.n.* (lecto: K, here redesignated), not as to excluded syntype *J. Drummond* 442 (which is *C. dorrienii* Domin).

Illustrations. M. Pocock, *Ground Orchids of Australia*, photo 19 [as *Caladenia filamentosa*] (1972); K.W. Dixon, B.J. Buirchell & M.T. Collins (eds) *Orchids of Western Australia*, plate a opposite page 41 (1989); A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 3 top right photo [as *Caladenia filamentosa*] (undated); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 55 (1992) and rev. 2nd edn with suppl., p. 55 (1998).

Plant solitary or in small clumps. **Leaf** erect, linear, 6–18 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. **Scape** 15–35 cm tall. **Flowers** 1 or 2(3), c. 6–10 cm across, pale yellow-cream or white (occasionally suffused pink or dark red), with dark maroon lines, spots and blotches; floral odour faint, fetid. **Sepals and petals** stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. **Dorsal sepal** erect and slightly incurved, 4–6.5 cm x 2–3 mm. **Lateral sepals** arching, spreading for one third their length, then downcurved, 4–6.5 cm x 2–3.5 mm. **Petals** arching, spreading for one third their length, then downcurved, 3.8–6 cm x 1.5–3 mm. **Labellum** white with pale brown-fawn markings, becoming large irregular spots and blotches towards margins and the recurved apex, stiffly articulate on a claw 1.5–2 mm wide; lamina narrowly rhomboidal in outline when flattened, 15–18 x 7–10 mm, 3-lobed, erect with entire margins in basal 2/5, nearly horizontal in middle 2/5, apical 1/5 sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli, distal margins dentate-serrate with narrow to truncate white to pale pink marginal calli decrescent towards the apex. **Lamina calli** in 8–13 pairs in 2 rows extending about half the length of the labellum, white, rarely pale pink, narrowly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. **Column** 12–15 x 5–7 mm, narrowly winged, creamy yellow with red blotches, glabrous. **Anther** c. 2–2.5 x 2–2.5 mm, pale yellow or greenish-yellow. **Pollinia** c. 2 mm long, yellow. **Stigma** c. 2.5–3 mm wide. **Capsule** not seen. (Figure 46Q–V)

Selected specimens examined. WESTERNAUSTRALIA: Arrowsmith River just W of Brand Highway, 19 Aug. 1984, *A. Brown s.n.* (PERTH 00277894); Cockleshell Gully on N side of creek, between Jurien Bay road and Coorow–Green Head road, 30°09'S, 115°06'E, 17 Aug. 1985, *A. Brown & S. van Leeuwen* 199 (PERTH 00900710); Gingin turnoff on the Brand Highway, c. 6 km S of Gingin, 31°24'S, 115°55'E, 4 Oct. 1985, *R. Clauson s.n.* (PERTH 00899615); 0.8 km E of Mogumber on road to New Norcia, 31°02'S, 116°03'E, 17 Sep. 1983, *R.J. Cranfield* 4130 (PERTH 00277908); 10 km N of Three Springs road along Eneabba–Mingenew road, 29°40'S, 115°25'E, 25 Aug. 1983, *S.D. Hopper* 3373 (CBG, K, PERTH 00277940); Julimar State Forest, 7.2 km E of The Midlands Rd on Northern Boundary Rd, 31°21'S, 116°08'E, 31 Aug. 1984, *S.D. Hopper* 3992 (CBG, PERTH 00277517); Mortlock River

Bridge on Goomalling–Calingiri road, 31°13'S, 116°44'E, 25 Sep. 1984, *S.D. Hopper* 4163 (PERTH 00277479); 6.7 km N of Waroona on Armadale–Bunbury highway, 32°48'S, 115°54'E, 17 Sep. 1985, *S.D. Hopper* 4603 (CBG, K, PERTH 00910694); Gunyidi–Wubin road, 2.7 km W of Masons Rd, 30°08'S, 116°14'E, 23 Aug. 1988, *S.D. Hopper* 6500 (PERTH 00858838); Monk's Well Gully, 1.5 km E of Mount Rupert Station in the Wongan Hills, 30°47'S, 116°38'E, 13 Sep. 1987, *K.F. Kenneally* 10588 (PERTH 01219979).

Distribution and habitat. Widespread between Lake Moore and Yarloop in a wide range of habitats from Wandoo and York Gum woodland to granitic areas in Jarrah forest and moist margins of winter-wet swamps. Soils range from clay-loam to deep sand. (Figure 47A)

Flowering period. September to October.

Lectotypification. *Caladenia filamentosa* var. *pallens* has been interpreted either as a synonym of the species we recognize as *C. denticulata* (George 1971) or as a synonym of *C. dorrienii* (Clements 1989).

The protologue of *Caladenia filamentosa* var. *pallens* reads as follows: "Flowers apparently pink, the points of the sepals not so long nor so fine as in the ordinary *C. filamentosa*. – Swan River, *Drummond*, n. 442, *Mylne*." (Bentham 1873: 381).

George (1971) correctly considered *Caladenia filamentosa* var. *pallens* to be a synonym of *C. denticulata*, but incorrectly lectotyped the taxon on the *Drummond* 442 collection, a choice of lectotype supported by Clements (1989). We have examined both collections cited by Bentham (*Drummond* 442 and *Mylne* s.n.), and consider that the *Mylne* collection provides a better match with the protologue.

The *Drummond* 442 sheet comprises 8 specimens, all with cream (not pink) flowers, and finely acuminate (as in other *Caladenia filamentosa* complex taxa) petals and sepals to 30 mm long. In our view, and that of M. Clements (determinavit slip dated 13 June 1983), these plants are all *C. dorrienii*, not *C. denticulata*. They do not match the protologue above for *C. filamentosa* var. *pallens* in two of the three characters given (i.e. "flowers apparently pink", and "points of the sepals not ... so fine as in the ordinary *C. filamentosa*.").

The *Mylne* sheet, on the other hand, is a much better match with the protologue. It has five specimens, three with flowers, two yellow and one apparently pink, and all clearly with petals and sepals broken off to a length of 15–20 mm, giving the appearance of thicker apices than normal for *Caladenia filamentosa* complex taxa. In our view, these are damaged specimens of *C. denticulata*, showing typical colour variation for this species from yellowish through to pink-maroon.

The clear mismatch of characters of the *Drummond* 442 specimens with the protologue calls for relectotypification of *Caladenia filamentosa* var. *pallens*, and the *Mylne* collection is therefore nominated above as the lectotype.

Notes. The identity of this species has been confused and misinterpreted by many authors, including ourselves. When he first described *Caladenia denticulata*, Lindley (1840) did not provide diagnostic characters sufficient to discriminate the species from many other members of the *C. filamentosa* complex. Indeed, despite several differences between *C. denticulata* and *C. filifera* in labellum and tepal size, shape and structure, Lindley identified only colour differences when he named both species in the same publication (i.e. 'flowers purple' for *C. filifera*; 'flowers yellow' for *C. denticulata*).

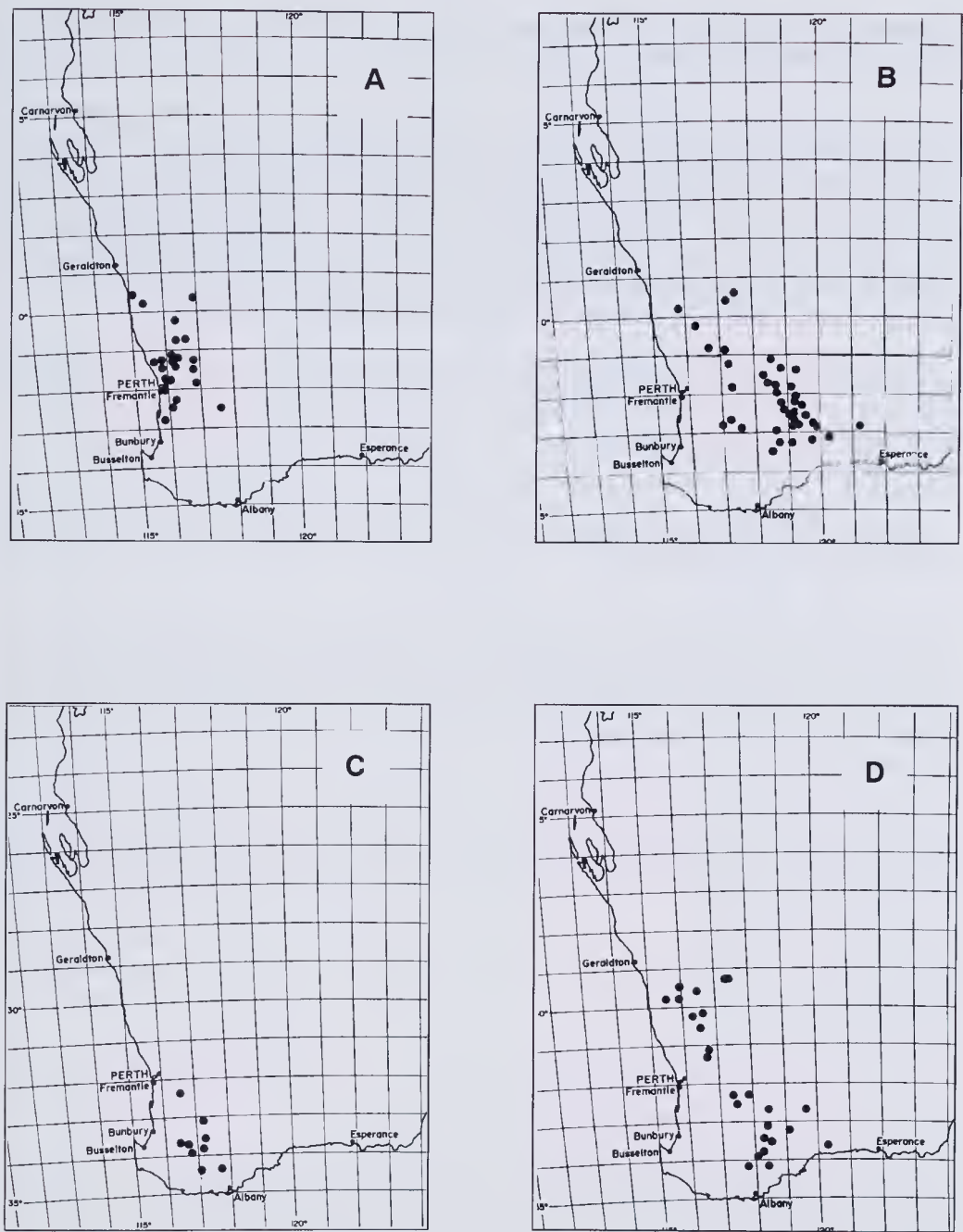


Figure 47. Distribution maps. A – *Caladenia denticulata*; B – *C. dimidia*; C – *C. dorrienii*; D – *C. douthiae*.

Reichenbach (1871) regarded *C. denticulata* as a variety of *C. filamentosa*, but again did not adequately diagnose the two taxa.

Bentham (1873) subsequently synonymized *Caladenia denticulata* under *C. filamentosa* without comment, being more concerned at the time with countering F. Mueller's assertion that *C. filamentosa* and *C. patersonii* were conspecific, rather than entertaining the prospect that these taxa may each comprise many species themselves. Bentham's view that *C. denticulata* was a synonym of *C. filamentosa* was followed by subsequent authors (e.g. Pelloe 1930; Nicholls 1969) until George (1971) followed Reichenbach in recognising *denticulata* as a variety of *C. filamentosa*. George did not describe the taxon nor provide a key to the varieties of *C. filamentosa* he recognised. Subsequently, George & Foote (undated) illustrated *C. denticulata* under the name *C. filamentosa*.

Hoffman & Brown (1984), following George's (1971) treatment and concept, as shown by annotated collections at the Western Australian Herbarium, used *Caladenia filamentosa* var. *denticulata* in the broad sense to cover many members of the *C. filamentosa* complex in Western Australia. The photo used to illustrate var. *denticulata* (on p. 80) is of *C. dimidia*.

Clements (1985), quoting unpublished research results obtained then by Hopper, reinstated *Caladenia denticulata* as a full species.

Rye (1987), on our advice, also treated *Caladenia denticulata* as a full species, but provided a general description and discussion suggesting that *C. denticulata* was 'extremely variable' and 'widespread', with the typical variant having 'somewhat larger perianth segments' than another variant (the taxon we describe below as *C. hiemalis*). At the time this work was drafted (1984), we had not seen the type collection of *C. denticulata* and had wrongly inferred it to be what we now recognize as *C. vulgata*.

Like Rye (1987) and Clements (1985), Jones (1988) considered *Caladenia denticulata* to be a species but used the name in the broad sense to cover most taxa in the *C. filamentosa* complex in Western Australia. His colour illustration (p. 113) is of *C. polychroma*, not *C. denticulata sens. str.*

Clements (1989), after study of the types, again recognized *Caladenia denticulata*, but cited Hoffman & Brown's (1984) photo of *C. dimidia* as an illustration. Brown (1989) provided the first published correctly labelled illustration of *C. denticulata* since the original drawing prepared for Lindley's description.

On examination of the type collection (especially the lectotype of *Caladenia denticulata*) the identity of the taxon is now clear, and is described above.

Caladenia denticulata is a locally common but patchily distributed species, ranging from Yarloop north to the Lake Moore area. It often grows in moist sites in Wandoo or York Gum woodlands. It is probably from this habitat that it was first collected by Drummond during his regular trips between Perth and his farm *Hawthornden* near Toodyay. *C. denticulata* is similar to *C. polychroma*, differing in its narrower paler-coloured labellum with narrow well-spaced labellum teeth, and the arching petals and lateral sepals with a pendulous apex. *C. denticulata* sometimes grows with *C. vulgata*, but the latter differs in its relatively broader labellum with a less erect basal lamina, its broader more crowded marginal cells, and paler longer petals and lateral sepals.

Caladenia denticulata is related to *C. postea*, differing in its generally taller scapes and larger flowers with a longer labellum, taller column, variable colouration, and its earlier flowering period.

Caladenia dimidia* Hopper & A.P. Br., *sp. nov.

A *Caladenia polychroma* Hopper & A.P. Brown floribus parvioribus sepalis lateralibus 4.5–8 cm longis 2–3.5 mm latis, columna 6–11 mm alta et labello 7–12 mm longo 6–9 mm lato differt.

Typus: Jackson Rock, c. 100 km south-east of Hyden, 32°49'S, 119°51'E, Western Australia, 31 August 1986, S.D. Hopper 5360 (*holo*: PERTH 01196634).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 80 [as *Caladenia filamentosa* var. *denticulata*] (1984), 2nd edn, p. 50 (1992) and rev. 2nd edn with suppl., p. 50 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 7–15 cm x 2–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1 or 2(3), c. 4–9 cm across, pale yellow-cream or white (occasionally suffused pink), with dark maroon lines, spots and blotches; floral odour faint, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal third, then abruptly narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–7 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, 5–7.5 cm x 2–3 mm. *Petals* spreading obliquely upwards to horizontal, 4.5–6.5 cm x 2–3 mm. *Labellum* pale yellow-cream with prominent radiating maroon stripes and markings, becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina rhomboidal in outline when flattened, 7–11 x 6–8 mm, 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending calli, distal margins dentate with truncate white to pale pink marginal calli decrescent towards the apex. *Lamina calli* in 6–14 pairs in 2 rows extending about half the length of the labellum, creamy-white, rarely pale pink, narrowly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 6–10 x 3–5 mm, narrowly winged, creamy yellow with red blotches, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5–2 x 1.5–2 mm, pale yellow or greenish-yellow. *Pollinia* c. 1–1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 48)

Selected specimens examined. WESTERN AUSTRALIA: Warralakin Rd, c. 34 km N of Great Eastern Highway, 31°04'S, 118°34'E, 15 Aug. 1988, A. Brown 828 (PERTH 01198319); c. 200 m E of crossing of Cunderdin–Minnivale road, 15 km E of Dowerin, 31°11'S, 117°11'E, 31 Aug. 1984, S.D. Hopper 3996b (CBG, PERTH 00272140); Strawberry Rocks, 26 km S of Southern Cross, 31°27'S, 119°17'E, 5 Sep. 1984, S.D. Hopper 4054 (CBG, PERTH 00271160); Mt Hampton Nature Reserve, 72 km NE of Narembeen, 31°45'S, 119°04'E, 5 Sep. 1984, S.D. Hopper 4061 (PERTH 00272620); Pallarup Rock, 44.5 km NNW of Ravensthorpe, 33°15'S, 119°45'E, 6 Sep. 1984, S.D. Hopper 4094a,b (PERTH 01935178); 7.7 km E of Lily McCarthy Rd on Holt Rock–Kulin road, 32°43'S, 119°17'E, 13 Sep. 1985, S.D. Hopper 4570 (CBG, PERTH 00903264); near Jackson Rock, c. 100 km SE of Hyden, 32°47'S, 119°47'E, 30 Aug. 1986, S.D. Hopper 5336 (PERTH 01196723); Gunyidi–Wubin road, 2.7 km W of Mason's Rd, 30°08'S, 116°14'E, 23 Aug. 1988, S.D. Hopper 6502 (PERTH 01197169); Lillian Stoke Rock, 33°03'S, 120°06'E, 6 Sep. 91, S.D. Hopper 8156 (PERTH 1829025).

Distribution and habitat. Extends from near Paynes Find south-eastwards through the wheatbelt to near Ravensthorpe and Esperance. Occurs on loamy soils, often in mallee and scrub adjacent to granite

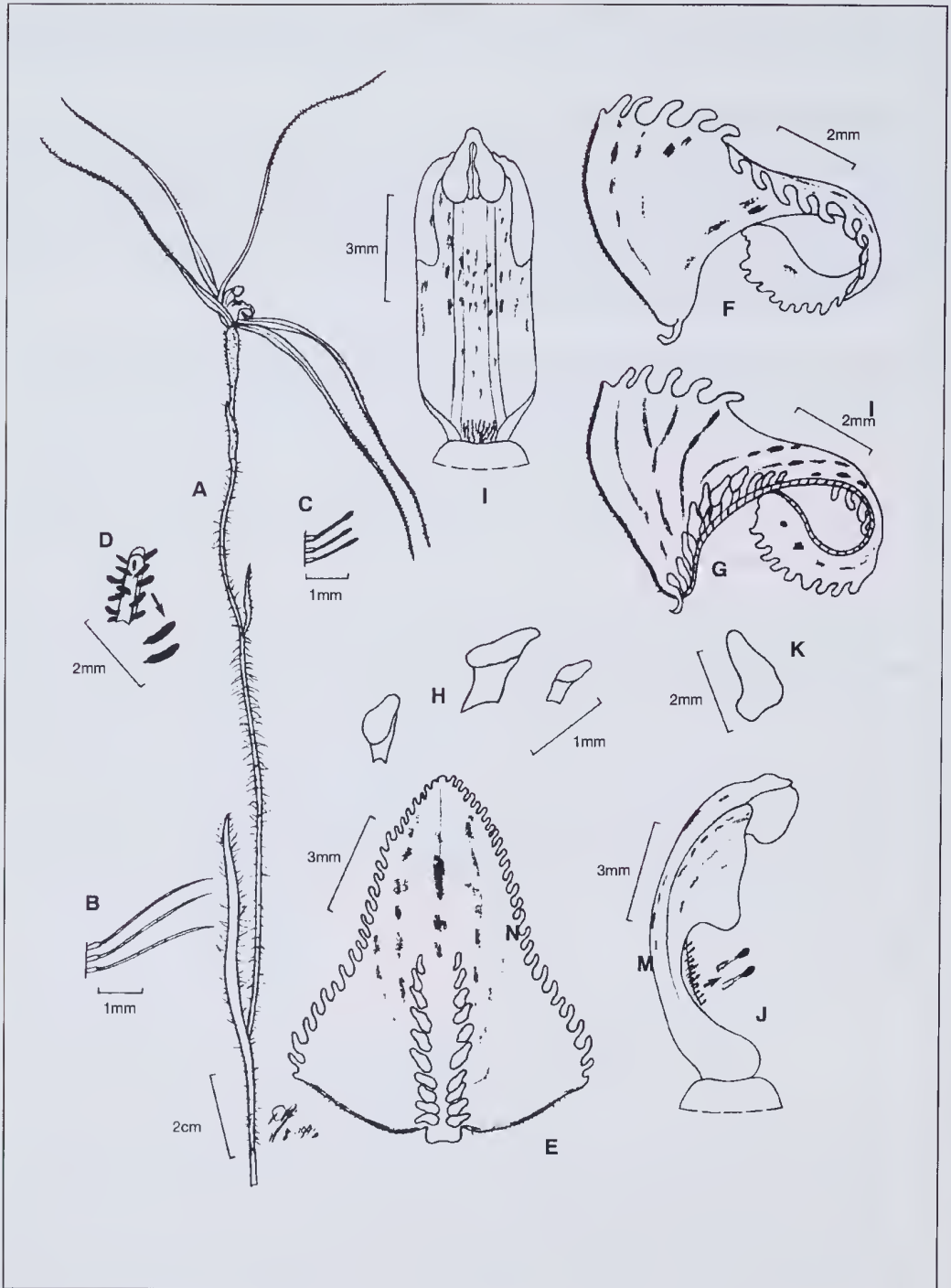


Figure 48. *Caladenia dimidia* from Jilakin Rock, C.J. French s.n. A – plant; B – hairs from lower scape; C – hairs from upper scape; D – hairs from tepal apex; E – flattened labellum from above; F – labellum from side; G – longitudinally sectioned labellum from side; H – labellum lamina calli; I – column from front; J – column from side; K – Pollinia. Drawn by D.L. Jones.

outcrops or other seasonally wet habitats. (Figure 47B)

Flowering period. Mid August to late September.

Etymology. Named from the Latin *dimidius* (half), alluding to the intermediate size of the labellum between those of *Caladenia polychroma* and *C. paradoxa*, the former of which is variable in colouration like *C. dimidia*.

Notes. *Caladenia dimidia* is related to *C. polychroma* in its stiffly splayed and often colourful petals and sepals. However, *C. dimidia* is consistently smaller, the filiform apices are only two-thirds the total length of its petals and sepals, and it has a more northerly range, overlapping with *C. polychroma* in the central wheatbelt where the two species occasionally hybridise. *C. dimidia* also occurs in drier habitats than the Wandoo and Swamp Yate flats favoured by *C. polychroma*.

Caladenia dimidia hybridizes sporadically with *C. paradoxa* at locations such as Warralakin, Hines Hill and Wubin. *C. dimidia* differs from *C. paradoxa* in its shorter and more stiffly held spreading sepals and petals, and in its somewhat broader labellum.

Uncommon yellow forms of *Caladenia dimidia* occur near the rare *C. luteola*, but differ in their smaller flowers, their closely spaced marginal calli on the labellum lamina, and the non-glistening tops to the central calli.

Caladenia dorrienii Domin, *J. Proc. Linn. Soc., Bot.* 41: 251, t, 12, f. 23 (1912). – *Caladenia filamentosa* var. *dorrienii* (Domin) A.S. George, *Nuytsia* 1(2): 170 (1971). *Type:* Bridgetown to Kojonup and Slab Hut Gully, Western Australia, 1910, A. Dorrien-Smith s.n. (*holo:* K).

Illustrations. K.W. Dixon, B.J. Buirchell & M.T. Collins (eds), *Orchids of Western Australia*, plate c3 opposite page 60 (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 76 [as *Caladenia filamentosa* var. *dorrienii*] (1984), 2nd edn, p. 29 (1992) and rev. 2nd edn with suppl., p. 29 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), *Western Australia's Threatened Flora*, p. 114 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 6–10 cm x 3–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 10–20 cm tall. *Flowers* 1–3, c. 2–3 cm across, pale yellow-cream to white with maroon lines, spots and blotches; floral odour apparently absent. *Sepals and petals* stiffly held, linear-lanceolate in basal half, gradually narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 2–3 cm x 2.5–3 mm. *Lateral sepals* downcurved and incurved so as to cross in front of the ovary, 2–3 cm x 2.5–3 mm. *Petals* erect spreading horizontally, then downcurved and incurved, 2–3 cm x 2–2.5 mm. *Labellum* bright white with faint radiating basal lines becoming large irregular spots and blotches towards the recurved apex and margins, stiffly articulate on a claw c. 1 mm wide; lamina rhomboidal in outline when flattened, 12–15 x 7–10 mm, prominently 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly descending margins, distal margins entire or sparsely serrate with white narrowly triangular to uncinatate marginal calli decrescent towards the apex. *Lamina calli* in 6–10 pairs in 2 rows extending at least half the length of the labellum, bright white with red-fawn markings, anvil-shaped, the longest c. 1 mm tall, rarely decrescent distally. *Column* 10–12 x 3–5 mm, narrowly winged, greenish-cream with red

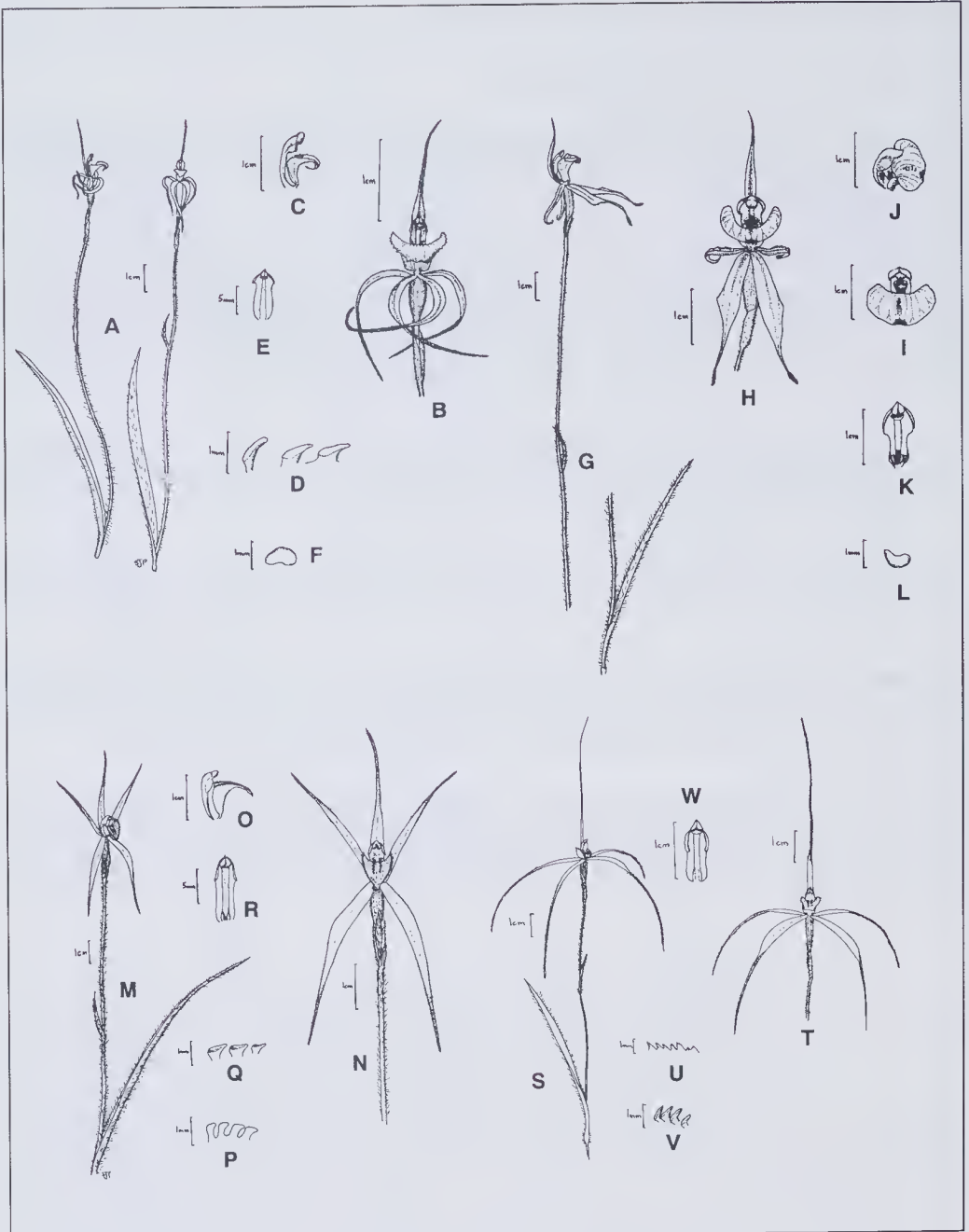


Figure 49 A–F. *Caladenia dorrienii* from the Frankland area, A.P. Brown s.n. A – plant from front and side; B – flower from front; C – labellum and column from side; D – calli; E – column from front; F – pollinia. G–L. *C. douchiae* from west of Carnamah, A.P. Brown s.n. G – plant; H – flower; I – labellum and column from above; J – labellum and column from side; K – column from front; L – pollinia. M–R. *C. evanescens* from Peaceful Bay, R. Bates 4454. M – plant; N – flower; O – labellum and column from side; P – labellum fringe; Q – calli; R – column from front. S–W. *C. exilis* subsp. *exilis* from north-east of Watheroo, A.P. Brown s.n. S – plant; T – flower; U – labellum fringe; V – calli; W – column from front. Drawn by S.J. Patrick.

blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 2 x 2 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 49A–F)

Selected specimens examined. WESTERN AUSTRALIA: near Frankland, 15 Oct. 1980, *A. Brown* s.n. (PERTH 00237221); Highbury and Kojonup, 33°30'S, 117°10'E, Oct. 1924, *B.T. Goadby* s.n. (PERTH 00237205); SSE of Kulikup, 6 Oct. 1983, *S.D. Hopper* 3481 (PERTH 00237256); Brookton Highway, 20 Oct. 1987, *S.D. Hopper* 6242 (PERTH 01191403).

Distribution and habitat. Mainly found between Frankland and Kojonup, with a disjunct occurrence at West Dale. Grows under scattered Wandoo in sandy clay soil amongst low shrubs, annuals and dense low herbs. (Figure 47C)

Flowering period. Late September to November.

Notes. Although sometimes locally common, this Declared Rare species is now known from just a few sites between Kojonup and West Dale due to the clearing of much of its former habitat. Although regarded as a variety of *Caladenia filamentosa* by George (1971), it is a distinctive species readily distinguished from other members of the *C. filamentosa* complex by its prominently downcurved petals and sepals, the latter crossing in front of the ovary and its labellum with widely spaced marginal calli and prominent irregular spots and blotches.

Caladenia dorrienii is one of many species first collected and separately numbered by James Drummond in the late 1830s but not taken up and named by Lindley and subsequent botanists who examined Drummond's collections at Kew.

Drummond probably collected his specimens from the vicinity of Toodyay or westwards towards Perth, as this was the region where he collected orchids intensively in 1837 and 1838. If this is correct, there has been only one subsequent record of the species in this northern part of its range (*Hopper* 6242), despite intensive survey by orchid enthusiasts. However, renewed searches along the Toodyay road in Wandoo flats may well be justified for the species.

Domin (1912), who apparently was not aware of Drummond's earlier collections when he named *Caladenia dorrienii*, used specimens collected by Dorrien-Smith in 1910 to describe the species. Thereafter, the species remained poorly known and "thought to be a form of *C. filamentosa*" (Erickson 1965), a view formalised by George (1971) when he reduced *C. dorrienii* to varietal status. More recently (Jones 1988; Clements 1989; Brown 1989; Hoffman & Brown 1992), the taxon has been reinstated to full species status.

Clements (1989) regarded *Caladenia filamentosa* var. *pallens* Benth. as a synonym of *C. dorrienii*, but this is based on an incorrect lectotypification (see notes under *C. denticulata*).

Caladenia douthiae O. Sarg., *J. Bot.* 59: 175 (1921). *Type:* Datatine, east Katanning, Western Australia, September 1919, *L. Douth* ex *O.H. Sargent* 822 (*holo:* PERTH 01545620; *iso:* BM).

Illustrations. W. Nicholls, *Orchids of Australia*, plate 234a (bottom two flowers), f, g, h [as *Caladenia roei*] (1969); M. Pocock, *Ground Orchids of Australia*, photo 37 (1972); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 3, page 9 B1 & B2 (1984); N. Hoffman & A. Brown, *Orchids of*

South-West Australia, 2nd edn, p. 136 (1992) and rev. 2nd edn with suppl., p. 136 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 5–15 cm x 3–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 5–30 cm tall. *Flowers* 1, very rarely 2, c. 1–3 cm across, predominantly pale yellow-green to pinkish maroon with variable suffusions and lines of dull maroon; floral odour absent. *Sepals and petals* stiffly held with an osmophore present only on lateral sepals. *Dorsal sepal* erect to slightly recurved, 1.8–3.0 cm x 2–2.5 mm, linear to slightly tapering in basal 2/3, narrowing to an acute apex. *Lateral sepals* straight, spreading obliquely downwards, 1.8–3.0 cm x 4–7 mm, basal half narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point, narrowing abruptly to an elongate filamentous apical half terminating in a shortly cylindrical tumescent pink or fawn to yellow osmophore 1–4 mm long, consisting of minute densely packed globular sessile glandular cells. *Petals* thrust sharply downward (sometimes obliquely), linear to somewhat tapering, 1.2–2.3 cm x 1.5–3 mm, narrowing to an acute often recurved apex. *Labellum* 8–12 x 11–17 mm, 3-lobed with a tiny apical midlobe, prominently 2-coloured, yellowish-green to pinkish maroon with red to dark brown radiating stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina laterally oval with a small obtuse apex in outline when flattened, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal terminating in the last 2–3 mm in a sharply recurved apex, margins at widest point scarcely curved upwards and terminated by slightly descending margins; lateral lobes erect to horizontal with entire margins; midlobe margins entire. *Lamina calli* aggregated in a dense central band to 1 mm wide extending at least 2/3 the length of the labellum and stopping short of the dark maroon apex, dark purplish maroon with a pale base, erect, linear, capitate with a shiny globular head, the longest c. 1.5 mm tall, slightly decrescent towards apex. *Column* 10–13 x 4–7 mm, broadly winged, greenish-yellow with maroon blotches. *Anther* c. 2–2.5 x 2.5 mm, yellow-green. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide, yellow-green. *Capsule* not seen. (Figure 49G–L)

Selected specimens examined. WESTERN AUSTRALIA: Eneabba–Carnamah road, just S of Yarra Yarra Lakes, 19 Aug. 1984, A. Brown s.n. (PERTH 00238171); 400 m N of Bullaring–Pingelly road on Bulyee Rd, 32°31'S, 117°31'E, 7 Sep. 1984, S.D. Hopper 4129 (PERTH 00240591); W bank of Mortlock River, 39.5 km NE of Toodyay on road to Goomalling, 31°21'S, 116°46'E, 25 Sep. 1984, S.D. Hopper 4161 (PERTH 00241148); Lake Chinocup, 33°32'S, 118°24'E, 2 Oct. 1984, S.D. Hopper 4175 (PERTH 00240605); Mason's Rd, 15.5 km N of Carot Well Rd, 30°08'S, 116°16'E, 23 Aug. 1988, S.D. Hopper 6494 (PERTH 01190318 CBG); 2 km S of Camel Soak, 29°24'S, 116°37'E, 28 Aug. 1988, S.D. Hopper 6566 (AD, CBG, K, MEL, PERTH 01190393); Southern Cross–Hatters Hill road, c. 5.3 km S of the Hyden–Norseman road, 32°31'S, 119°47'E, 29 Sep. 1988, S.D. Hopper 6884 (CBG, PERTH 01176137); 8 km ENE along Borden–Bremer Bay road from Boxwood Hill, 34°22'S, 118°45'E, 1 Oct. 1985, R. Peakall 0056 (PERTH 00561037).

Distribution and habitat. Widespread throughout the wheatbelt between Geraldton, Paynes Find and the Ravensthorpe area. Occurs in mallee woodlands and shrublands, particularly surrounding salt flats and lakes, and on inland granite outcrops. (Figure 47 D)

Flowering period. August to October.

Notes. A common widespread species found throughout the central and western wheatbelt. It was previously thought to be a single variable species but is now known to consist of three species (*Caladenia brevisura*, *C. douchiae* and *C. incrassata*) which overlap in their distributions only along

their boundaries. *C. douthiae* differs from both other species in having an elongate tip to its sepals, a generally broader labellum with a narrower band of calli and a more westerly distribution between Geraldton, Paynes Find and the Ravensthorpe area. Occasional intermediates occur in the Ravensthorpe area where the distributions of *C. douthiae* and *C. brevisura* overlap.

***Caladenia dundasiae* Hopper & A.P. Br., sp. nov.**

A *Caladenia filifera* Lindl. petalis sepalisque brevioribus et colore variabili florum differt.

Typus: Watheroo West Rd, 1.7 km west of The Midlands Rd, 30°15'S, 116°01'E, Western Australia, 4 August 1996, A.P. Brown 2007 (*holo*: PERTH; *iso*: AD, CBG).

Illustration. N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 417 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 4.5–15 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scapes* 15–35 cm tall. *Flowers* 1 or 2, c. 6–8 cm across, uniformly blood red except cream basal labellum lamina, rarely cream or yellow with red markings; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/7–1/6, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5.5–6.5 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, 5.5–6.5 cm x 2–3 mm. *Petals* obliquely ascending to spreading obliquely downwards, 4–5 cm x 1.5–2 mm. *Labellum* cream basally with prominent blood red radiating lines, becoming uniformly red towards apex, stiffly articulate on a claw c. 1–1.5 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 7–10 x 4–6 mm, obscurely to prominently 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending margins and calli, distal margins serrate-dentate with truncate to triangular forwardly uncinate blood red marginal calli, decrescent towards the apex. *Lamina calli* in 8–12 pairs in 2 rows extending about 2/3–3/4 the length of the labellum, blood red with cream markings, sometimes paler proximally, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 7–10 x 2.5–3 mm, narrowly winged, blood red with cream markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5 x 1.5 mm, cream and blood-red. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 50)

Selected specimen examined. WESTERNAUSTRALIA: Watheroo West Rd, 1.7 km W of The Midlands Rd, 30°15'S, 116°01'E, 6 Aug. 1996, *C. French s.n.* (PERTH 00899577).

Distribution and habitat. Apparently confined to the Watheroo area growing in well drained pale clay-loam soils under scattered Wandoo and York Gum. (Figure 51A)

Flowering period. July to August.

Etymology. Named from after Patricia Dundas (1951–), botanical artist and keen orchid enthusiast, who first drew the species to our attention.

Notes. *Caladenia dundasiae* is a poorly known species first recorded in the early 1990s. It is allied to *C. filifera*, from which it differs in its broader more stiffly held flowers with generally shorter petals and sepals, and its smaller labellum with a cream basal lamina and central calli extending further towards

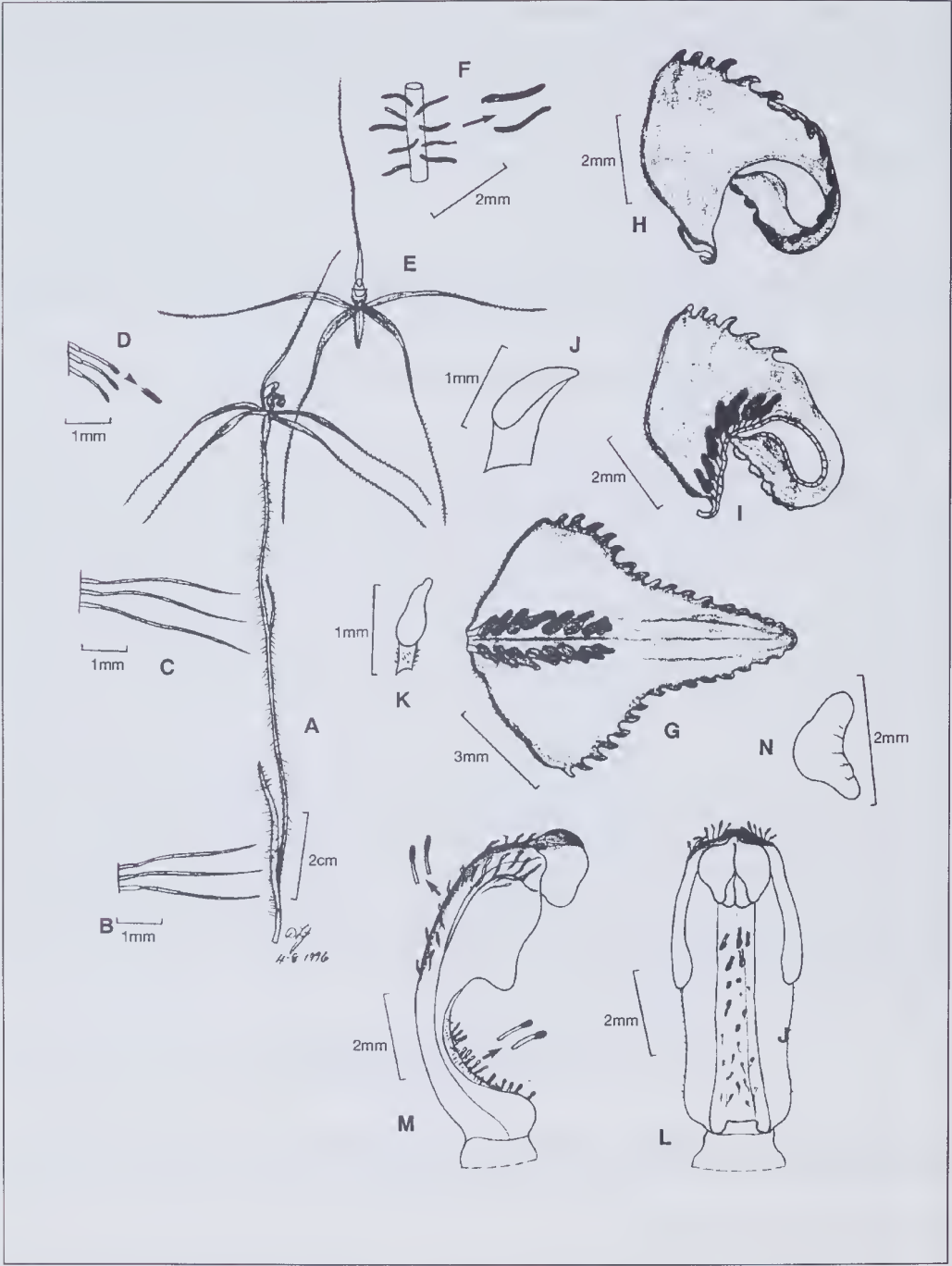


Figure 50. *Caladenia dundasiae* from Watheroo West Rd, C. French s.n. A – plant; B – leaf hairs; C – hairs from lower scape; D – hairs from upper scape; E – flower from front; F – hairs from tepal apex; G – flattened labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J, K – labellum lamina calli; L – column from front; M – column from side; N – pollinia. Drawn by D.L. Jones.

the apex. *C. dundasiae* is also winter-flowering, much earlier than other members of the Western Australian *C. filamentosa* complex growing nearby except for the cream-coloured and smaller-flowered *C. hiemalis*. Hybrids have not been recorded, possibly because of this strong seasonal isolation.

***Caladenia elegans* Hopper & A.P. Br., sp. nov.**

A *Caladenia vulgata* Hopper & A.P.Br. petalis sepalisque vivide citrinis atromarroninascentibus et glanduliferis in filamentis exilibus apicalibus differt.

Typus: west-north-west of Northampton, Western Australia, 24 August 1983, S.D. Hopper 3347 (*holo*: PERTH 00270733; *iso*: CBG).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 59 (1990) [as *Caladenia* sp. (Northampton)] S.D. Hopper 3347; N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 53 (1992) and rev. 2nd edn with suppl., p. 53 (1998); A. Brown, C. Thomson-Dans, & N. Marchant (eds), Western Australia's Threatened Flora, p. 132 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 6–12 cm x 3–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–30 cm tall. *Flowers* 1 or 2(3), c. 5–8 cm across, bright lemon yellow with dark maroon lines, spots and blotches; floral odour like burning metal. *Sepals and petals* stiffly held near base with a lax apex, linear-lanceolate in basal 1/5, then abruptly narrowing to a dark maroon densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs clongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5.5–10 cm x 2.5–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 7–11 cm x 2.5–4 mm. *Petals* spreading horizontally, then downcurved to vertical, 6.5–8.5 cm x 2.5–3 mm. *Labellum* usually cream with prominent maroon radiating basal lines often becoming irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 12–15 x 8–10 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending margins and calli, distal margins dentate with broadly truncate forwardly uncinuate white to pale yellow marginal calli decrescent towards the apex. *Lamina calli* in 6–13 pairs in 2 rows extending about half the length of the labellum, creamy-white, rarely with pale pink markings, glossy on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 10–12 x 5–7 mm, narrowly winged, creamy yellow with red blotches, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, pale yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 52)

Selected specimens examined. WESTERN AUSTRALIA: WNW of Northampton, 24 Aug. 1983, A. Brown 37 (PERTH 00335428); W of Northampton, 24 Aug. 1982, A. Brown s.n. (PERTH 00270768); WNW of Northampton, 18 Aug. 1985, A. Brown & S. van Leeuwen 204 (CBG, K, PERTH 00901156); WNW of Northampton, 24 Aug. 1983, S.D. Hopper 3348 (PERTH 00273651).

Distribution and habitat. Known only from north-west of Northampton, where it grows on wet clay flats amongst low dense shrubs and annuals under taller scattered *Hakea*, *Melaleuca* and *Acacia*. (Figure 51B)

Flowering period. Late July to August.

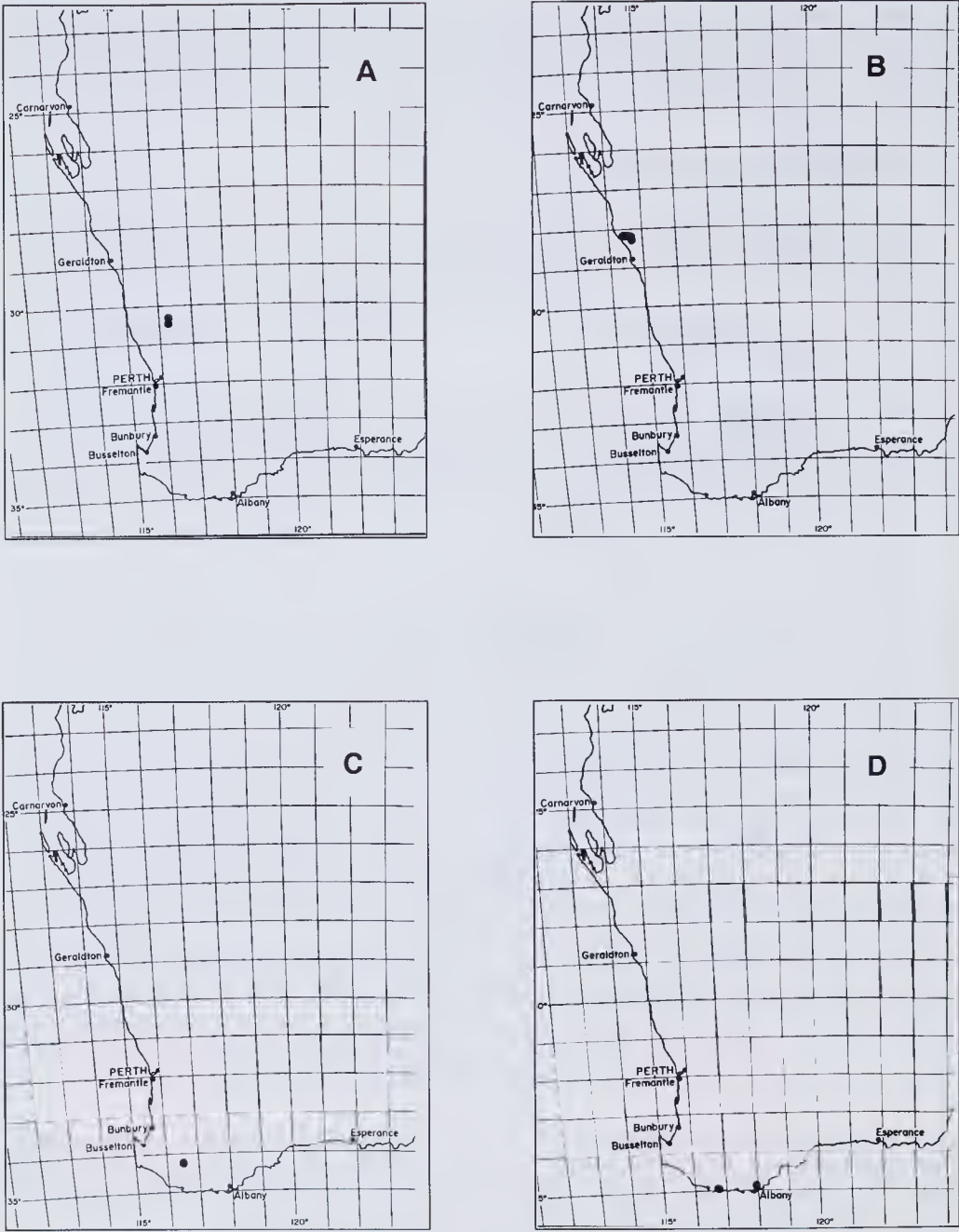


Figure 51. Distribution maps. A – *Caladenia dundasiae*; B – *C. elegans*; C – *C. erythrochila*; D – *C. evanescens*

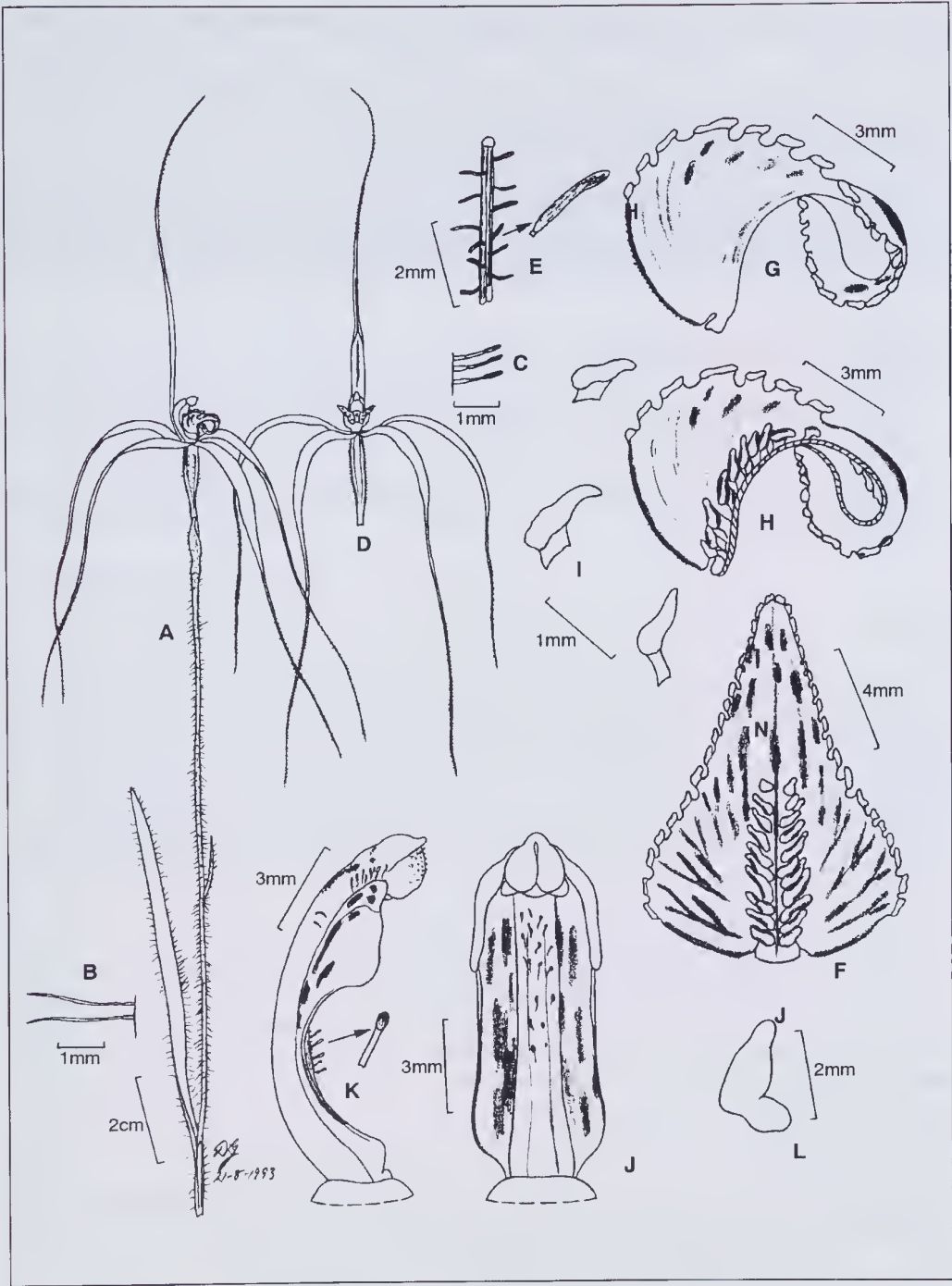


Figure 52. *Caladenia elegans* from the Northampton area, A.P. Brown s.n. A – plant; B – hairs from lower scape; C – glandular hairs from upper scape; D – flower from front; E – hairs from tepal apex; F – flattened labellum from above; G – labellum from side; H – longitudinally sectioned labellum from side; I – labellum lamina calli; J – column from front; K – column from side; L – pollinia. Drawn by D.L. Jones.

Etymology. Named from the Latin *elegans* (elegant) alluding to the attractive flowers of this species.

Notes. This species currently is declared as Rare Flora. Its nearest relative appears to be *Caladenia luteola*, from which it differs in its longer lateral sepals and petals stiffly held near the base with a lax apex, and its usually cream somewhat shorter labellum lamina.

Caladenia elegans occurs with the common and widespread *C. vulgata*. Although the two species often grow near each other, *C. elegans* differs in having bright lemon yellow flowers with the calli glossy on top, a wet clay habitat (*C. vulgata* grows in well drained soils further upslope), and a marginally earlier flowering period.

***Caladenia erythrochila* Hopper & A.P. Br., sp. nov.**

A *Caladenia pulchra* Hopper & A.P. Br. floribus brevioribus semper marroninis, sepalis lateralibus 4.5–5 cm longis, labello 5.5–6 mm longo, 2.5–3 mm latis differt.

Typus: Southfield Rd, 27 km from Mordalup Rd, Western Australia, 7 October 1995, W. Jackson 354 (*holo*: PERTH 04122712).

Illustration. N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 418 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 7–8.5 cm x 2–2.5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–25 cm tall. *Flowers* 1 or 2, c. 5–6 cm across, uniformly blood red; floral odour faint, like burning metal. *Sepals and petals* stiffly held basally with a lax apex, linear-lanceolate in basal 1/4–1/3; then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3.5–4 cm x c. 1.5 mm. *Lateral sepals* spreading obliquely downwards, 4.5–5 cm x c. 1.5 mm. *Petals* obliquely ascending to spreading obliquely downwards, 3–3.5 cm x c. 1.5 mm. *Labellum* blood red, stiffly articulate on a claw c. 0.5 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 5.5–6 x 2.5–3 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending margins and horizontal calli, distal margins serrate-dentate with truncate to triangular forwardly uncinuate blood red marginal calli, decrescent towards the apex. *Lamina calli* in 7–10 pairs in 2 rows extending about 4/5 the length of the labellum, cream, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* c. 5 x 2 mm, narrowly winged, blood red, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1 x 1 mm, blood-red. *Pollinia* c. 1 mm long, yellow. *Stigma* c. 1 mm wide. *Capsule* not seen.

Distribution and habitat. Apparently confined to an area north-west of Lake Muir, growing in well drained lateritic soils under scattered Jarrah. (Figure 51C)

Flowering period. Late September to early October.

Etymology. Named from the Greek *erythro* (red) and *chila* (lip), alluding to the striking and uniformly coloured blood-red labellum.

Notes. *Caladenia erythrochila* is a rare species (Priority Two) first recorded by forester Harry Winfield

in the 1970s. The only known collection is the type and despite considerable search effort in recent years, the species remains known from only two areas some 20 km apart with about 100 plants spread over several square km.

Caladenia erythrochila is distantly allied to *C. pulchra* and *C. filifera*, from which it differs in its more stiffly held and much smaller flowers. Possibly the nearest relative of *C. erythrochila* is *C. sanguinea* D.L. Jones from Kangaroo Island in South Australia (Jones 1999). *C. erythrochila* differs from *C. sanguinea* in its taller scapes, its somewhat shorter petals and lateral sepals with a lax pendulous apex, its narrower labellum that is linear-rhomboidal to triangular in outline when flattened, and its occurrence in acidic lateritic soils (calcareous limestone for *C. sanguinea*).

We consider *Caladenia erythrochila* to be specifically distinct from *C. filamentosa*, differing principally in its petals and lateral sepals with lax apices, its flattened labellum with the margins at the widest point scarcely curved upwards and its shorter broadly anvil-shaped cream lamina calli.

There is a complex of plants with flowers similar in size and colour to *Caladenia erythrochila* which are found in Victoria and mainland South Australia. These are apparently allied to typical *C. filamentosa* from Tasmania. Their relationships to *C. erythrochila* needs further investigation.

Caladenia evanescens* Hopper & A.P. Br., *sp. nov.

A *Caladenia abbreviata* Hopper & A.P. Br. petalis sepalisque brevioribus pallido-flavidis ad basin et apice labelli procurrenti externe non recurvata differt.

Typus: cultivated ex Peaceful Bay, c. 50 m due east of Peaceful Bay Chalets, 35°03'S, 116°55'E, Western Australia, 19 November 1985, R. Bates 4454 (*holo*: PERTH 00850934).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia*, plate d 4 opposite page 60 (1989) [as *Caladenia* species]; N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 26 (1992) and rev. 2nd edn with suppl., p. 26 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, to 13 cm x 5 mm, often withered when flowering, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–35 cm tall. *Flowers* solitary, c. 4 cm across, pale yellow-cream with dark maroon lines, spots and blotches; floral odour unknown. *Sepals and petals* stiffly held, linear-lanceolate in basal 2/3, then narrowing to a dark brown densely glandular acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3–4 cm x 2–3 mm. *Lateral sepals* obliquely downcurved, 3–4 cm x 2–3 mm. *Petals* erect to obliquely ascending, 2.5–3.5 cm x 1.5–2.5 mm. *Labellum* pale yellow-cream with thick dark radiating basal lines becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw 1.5–2 mm wide; lamina linear-rhomboidal in outline when flattened, 10–14 x 6–8 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in upper 2/3 (apex not sharply recurved), margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli, distal margins dentate with white broad truncate marginal calli decrescent towards the apex. *Lamina calli* in c. 10 pairs in 2 rows extending at least half the length of the labellum, white, anvil-shaped, the longest c. 1 mm tall, decrescent distally. *Column* c. 10 x 4 mm, narrowly winged, creamy yellow with red blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 2–3 x 2–3 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 49M–R)

Selected specimen examined. WESTERN AUSTRALIA: Albany, 3 Oct. 1962, R. Oliver s.n. (PERTH 00269255).

Distribution and habitat. Known from coastal heath near the base of consolidated sand dunes from Peaceful Bay to Albany on the south coast. Only seen (on two recent occasions) after summer wildfire. Possibly extends west to William Bay, where it has been photographed but specimens to verify the record have yet to be collected. (Figure 51D)

Flowering period. October to November.

Etymology. Named from the Latin *evanescens* (vanishing, quickly disappearing), alluding to the elusive appearance of the species.

Notes. A poorly known but rare species (Priority One) considered to be in urgent need of further survey to establish its conservation status. *Caladenia abbreviata* is the only other short-tepalled Western Australian member of the *C. filamentosa* complex to flower as late as *C. evanescens*. However, *C. evanescens* differs in its paler colouration, its shorter petals and sepals, its petals erect to obliquely ascending, and its projecting labellum apex.

Caladenia dorrienii and *C. melanema* also have abbreviated petals and sepals but differ from *C. evanescens* in having petals horizontal to downcurved, the labellum apex recurved, and a more inland distribution, while *C. bicallata* differs in having a smaller recurved labellum with calli in fewer pairs (less than 10) extending less than half way to the apex and a much earlier flowering period.

Caladenia evanescens was first collected by R. Oliver at Albany in 1962. Subsequently, it was not seen until 1984 when R. Bates brought a specimen from Peaceful Bay to our attention. It has not been seen since, despite searches of the Peaceful Bay site in 1985 and 1989, the latter following a summer wildfire.

***Caladenia exilis* Hopper & A.P. Br., sp. nov.**

A *Caladenia vulgata* Hopper & A.P. Br. similis sed labello minore angustiore et habitatione salsuginosa differt.

Typus: Nyabing, 33°30'S, 118°10'E, Western Australia, September 1990, R. Bates 23582 (*holo:* PERTH 04981502).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 4–10 cm x c. 4–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 16–25 cm tall. *Flowers* 1–3, c. 4–6 cm across, cream, with pale maroon lines, spots and blotches, or dark pinkish maroon to cream or variegated with prominent maroon stripes and suffusions; floral odour faint, usually like burning metal or putrid. *Sepals and petals* stiff or stiffly held near base with lax apex, linear-lanceolate in basal 1/6–1/5, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5–9 cm x 2–2.5 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 5–9 cm x 2.5–3 mm. *Petals* spreading horizontally, then downcurved to vertical, 5–7 cm x 1.5–2 mm. *Labellum* cream with dark maroon radiating basal lines, blotches and markings, stiffly articulate on a claw c. 1 mm wide; lamina

rhomboidal in outline when flattened, 8–12 x 5–7 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli, distal margins dentate-serrate with triangular forwardly uncinatate cream to dull maroon marginal calli, apex cream, decrescent towards the apex. *Lamina calli* in 7–12 pairs in 2 rows extending up to half the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 7–9 x 4–5 mm, narrowly winged, pinkish red or cream with fawn to maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5 x 1.5 mm, greenish-yellow. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen.

Distribution and habitat. A locally common species sporadically distributed in the wheatbelt from Mullewa south to the Woodanilling area. Grows in well-drained sands on the margins of salt lakes or rarely in seasonally wet flats, winter-wet depressions or seepages in seasonally wet sandy-clay-loam soil. Associated vegetation may be open scrub, Salmon Gum woodlands, York Gum woodlands or in granite outcrop shrublands and thickets. (Figure 53A)

Flowering period. Late June to September.

Etymology. Named from the Latin *exilis* (slender), alluding to the slender labellum, petals and sepals.

Notes. *Caladenia exilis* is a locally abundant often clump-forming species similar to *C. vulgata*, differing in its smaller, narrower more serrate labellum, shorter column, usually narrower sepals and petals, and in its confinement to salt lake margins and winter-wet flats. *C. pendens* also may grow near salt lakes, but it is larger-flowered with longer sepals and petals than *C. exilis*.

Near Esperance, there are populations that may well be *Caladenia exilis*. Plants in these populations have a similar narrow labellum, and occur on winter-wet flats, flowering best after fire. Their status requires further investigation.

Key to subspecies of *Caladenia exilis*

1. Flowers cream, with pale maroon lines, spots and blotches.
Growing in well-drained sands on the margins of salt lakes or rarely in seasonally wet flats. Flowering period late July to September subsp. *exilis*
- 1: Flowers dark pinkish maroon to cream or variegated with prominent maroon stripes and suffusions. Growing in sandy-clay-loam soils in winter-wet depressions, seepages or on granite outcrops.
Flowering period late June to early August..... subsp. *vanleeuwenii*

Caladenia exilis Hopper & A.P. Br. subsp. *exilis*

Caladenia varians subsp. *exilis* Hopper & A.P. Br. *nom inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, 32 (1992).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 32 [as *Caladenia varians* subsp. *exilis*] (1992) and rev. 2nd edn with suppl., p. 32 (1998).

Plant in small to large clumps. *Flowers* cream, with pale maroon lines, spots and blotches.

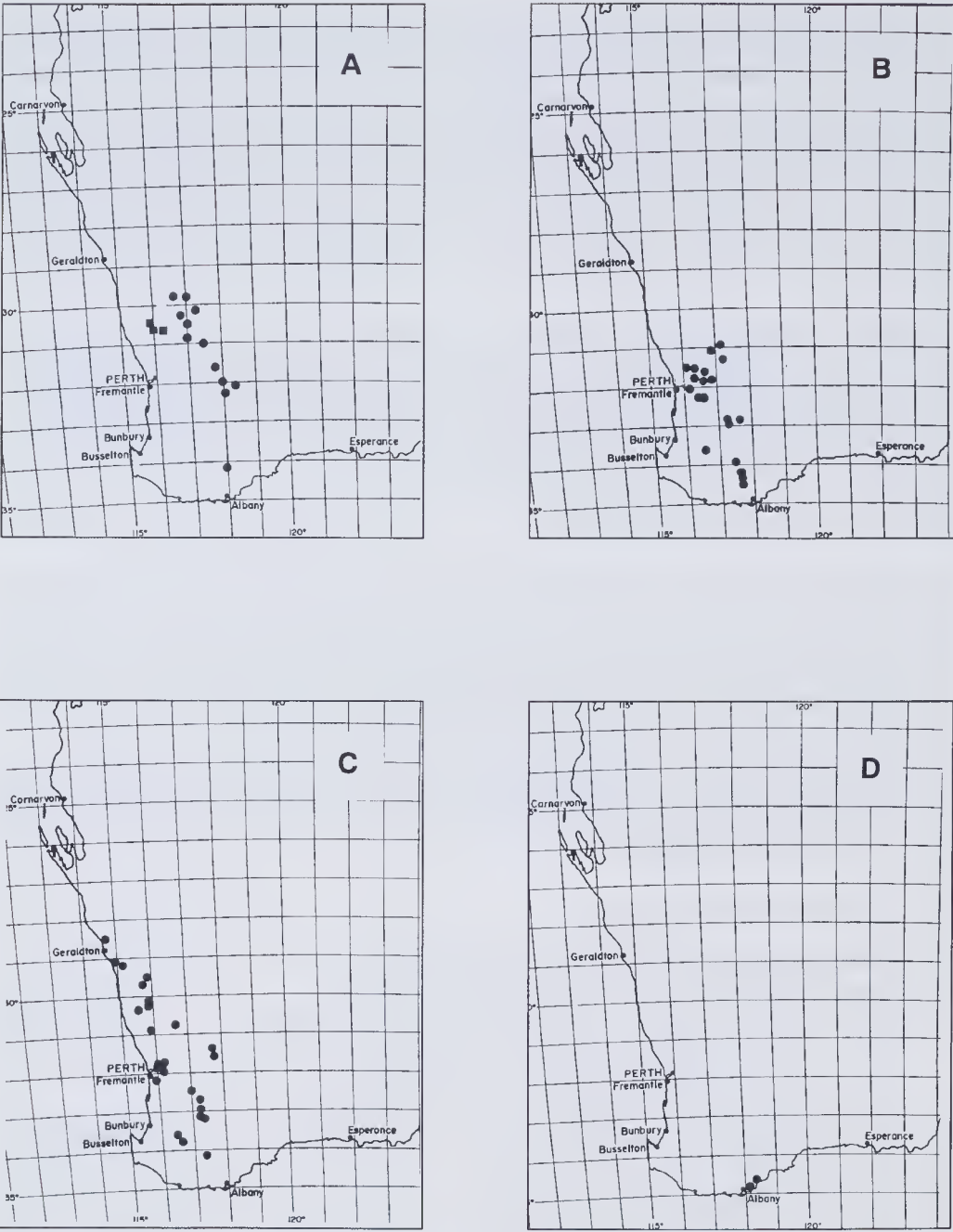


Figure 53. Distribution maps. A – *Caladenia exilis* subsp. *exilis* ● and *C. exilis* subsp. *vanleeuwenii* ■ ; B – *C. filifera*; C – *C. footeana*; D – *C. fuscolutescens*.

(Figure 49S–W)

Selected specimens examined. WESTERN AUSTRALIA: Gunyidi–Wubin road, 2.7 km W of Mason's Rd, c. 43 km NW of Dalwallinu, 30°08'S, 116°14'E, 23 Aug. 1988, S.D. Hopper 6501 (PERTH 01710613).

Distribution and habitat. Sporadically distributed in the wheatbelt from Mullewa south to the Woodanilling area. Grows in well-drained sands on the margins of salt lakes or rarely in seasonally wet flats in open scrub. (Figure 53A)

Flowering period. Late July to September.

Notes. This is the most widespread subspecies, typified by its consistently coloured cream flowers, predominant occurrence near salt lakes, and its somewhat later flowering season. The subspecies is becoming threatened due to rising saline watertables at many of its known locations.

On salt lake margins in the northern wheatbelt, rare hybrids between *Caladenia exilis* subsp. *exilis* and both *C. douchiae* and *C. roei* have been recorded.

Caladenia exilis* subsp. *vanleeuwenii Hopper & A.P. Br., *subsp. nov.*

Caladenia varians subsp. *vanleeuwenii* Hopper & A.P. Br. *nom inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, 41 (1992).

A subspeciebus typica sepalisque lateralibus albis vel roseis, marronineis lineis longitudinalibus rubris et florescentia hiemali differt.

Typus: 1 km north of Gillingarra townsite, 31°10'S, 116°20'E, Western Australia, 12 August 1997, G. Brockman 207 (*holo:* PERTH 05787920).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 41 [as *Caladenia varians* subsp. *vanleeuwenii*] (1992) and rev. 2nd edn with suppl., p. 41 (1998).

Plant solitary or in small clumps. *Flowers* dark pinkish maroon to cream with prominent maroon stripes and suffusions. (Figure 54)

Selected specimen examined. WESTERN AUSTRALIA: Midlands Rd, 23.5 km NNW of Bindoon, 25 July 1987, A.P. Brown 626 (PERTH).

Distribution and habitat. A geographically restricted subspecies confined to the Darling Fault north and south of Moora. Grows in winter-wet depressions or seepages in Salmon Gum or York Gum woodlands or on granite outcrops. Soils are loamy clays. (Figure 53A)

Flowering period. Late June to August.

Etymology. Named after Stephen van Leeuwen (1962–), research scientist with the Department of Conservation and Land Management since 1989. Stephen has assisted us on numerous occasions in

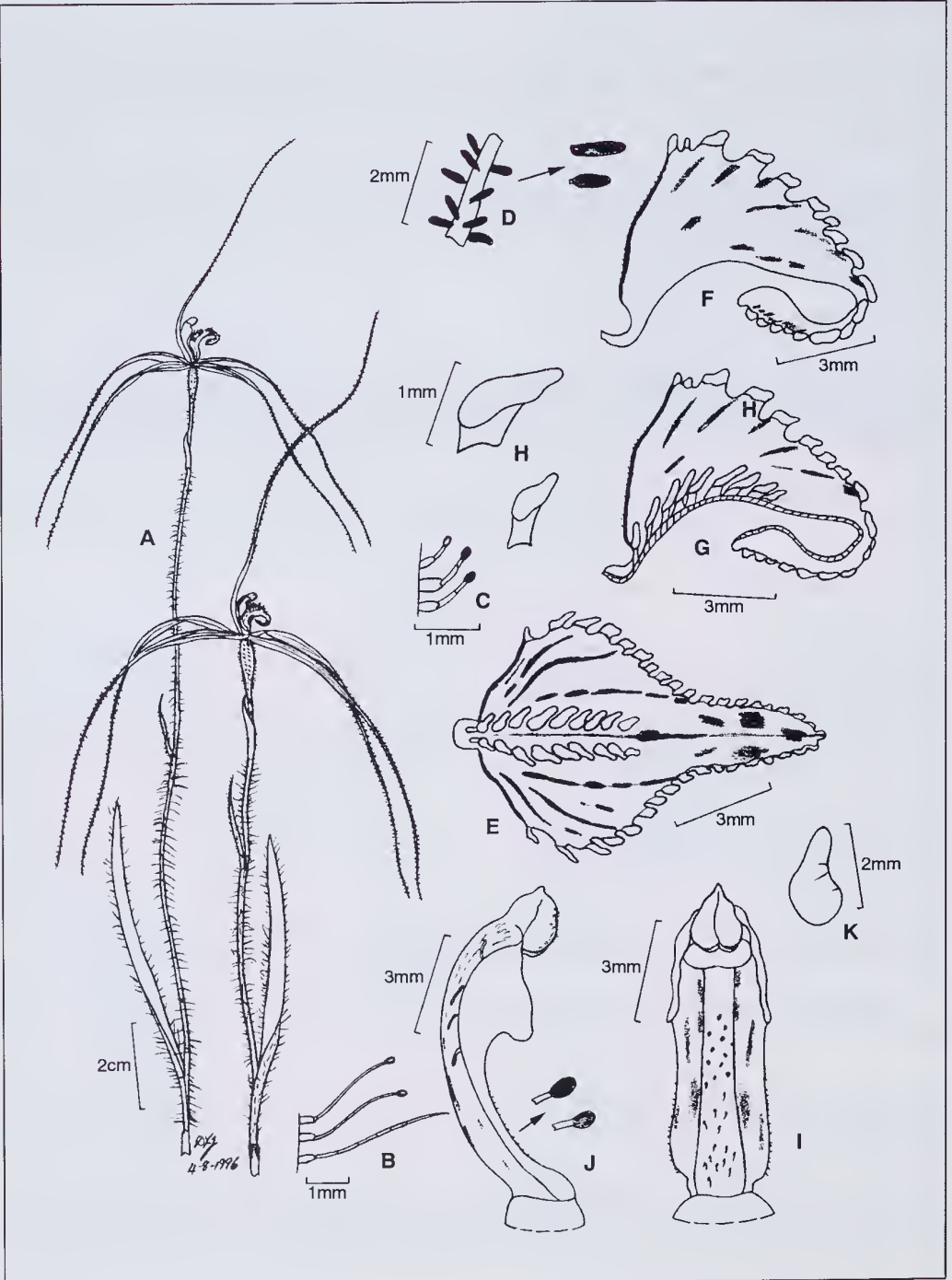


Figure 54. *Caladenia exilis* subsp. *vanleeuwenii* from the Moora area, C. J. French s.n. A – plants; B – leaf hairs; C – hairs from upper scape; D – hairs from tepal apex; E – flattened labellum from above; F – labellum from side; G – longitudinally sectioned labellum from side; H – labellum lamina calli; I – column from front; J – column from side; K – pollinia. Drawn by D.L. Jones.

the field, laboratory and herbarium in studies of rare and poorly known plants, including orchids. He was with A.P. Brown when *Caladenia exilis* subsp. *vanleeuwenii* was first collected in 1987.

Notes. *Caladenia exilis* subsp. *vanleeuwenii* has been seen at just three sites in heavily cleared farmland since the first collection was made. Its conservation status needs further study, as it may warrant declaration as Rare Flora under the Wildlife Conservation Act.

Caladenia filifera Lindl. in *Edward's Bot. Reg.* 1–23: Swan River Append. 1ii (1840). – *Caladenia filamentosa* var. *filifera* (Lindl.) H.G. Reichb., *Beitr. Pflanzensk.* 66 (1871). *Type:* Swan River [Western Australia], 1839, *J. Drummond s.n.* (*holo:* K-L! ; *iso:* BM! *n.v.*, FL *n.v.*, L *n.v.*)

Illustrations. D. Jones, *Native Orchids of Australia*, p. 118 (1988); K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia – cultivation and natural history*, plate 5a opposite p. 61 (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 98 [as *Caladenia filamentosa* var. *filifera*] (1984), 2nd edn, p. 46 (1992) and rev. 2nd edn with suppl., p. 46 (1998).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 6–15 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–45 cm tall. *Flowers* 1 or 2, rarely 3 or 4, c. 3–4 cm across, uniformly blood-red; floral odour faint, like burning metal. *Sepals and petals* stiffly held near base with a lax apex, linear-lanceolate in basal 1/9–1/7, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5–10 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 5–10 cm x 2.5–3.5 mm. *Petals* spreading horizontally, then downcurved to vertical, 5–10 cm x 2–3 mm. *Labellum* blood-red except for basal lamina sometimes creamy-pink with prominent blood-red radiating basal lines, stiffly articulate on a claw c. 1–1.5 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 10–15 x 6–10 mm, obscurely to prominently 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending margins and calli, distal margins serrate-dentate with broadly truncate to triangular forwardly uncinately blood-red marginal calli with apex cream or blood-red, decrescent towards the apex. *Lamina calli* in 6–12 pairs in 2 rows extending about 1/3–1/2 the length of the labellum, blood red, sometimes paler proximally, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 5–9 x 3–4 mm, narrowly winged, blood red with yellow markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5 x 1.5 mm, yellow and blood-red. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 55)

Selected specimens examined. WESTERNAUSTRALIA: 58 km from Kelmscott on Brookton Highway opposite first cleared farmland, 32°13'S, 116°24'E, 14 Aug. 1985, A. Brown 190 (PERTH 00906468); Send of Wongan Hills, 9 Aug. 1959, A.S. George 78 (PERTH 00243043); 7.5 km NNE of Mount Barker, 34°34'S, 117°42'E, 30 Sep. 1983, S.D. Hopper 3403 (CBG, PERTH 00243000); 26 km ENE of Wilga Siding, 33°39'S, 116°30'E, 6 Oct. 1983, S.D. Hopper 3472 (CBG, PERTH 00243027); Stirling Range National Park; 12 km E of Cranbrook, 34°19'S, 117°41'E, 7 Oct. 1983, S.D. Hopper 3500b (PERTH 01669605); 6 km NE of Bindoon, 31°22'S, 116°09'E, 31 Aug. 1984, S.D. Hopper 3989 (CBG, PERTH 00242594); c. 200 m E of crossing of Cunderdin–Minnivale road, 13°11'S, 117°11'E, 31 Aug. 1984, S.D. Hopper 3995 (PERTH 00242578); Malyalling Rock, 12 km NE of Wickepin, 32°43'S, 117°37'E, 7 Sep. 1984, S.D. Hopper 4122 (PERTH 00242977); 1 km S of Cuballing on Great Southern Highway, 32°50'S, 117°11'E, 2 Oct. 1984, S.D. Hopper 4170 (PERTH 00242969).

Distribution and habitat. Found along the western edge of the wheatbelt between Tenterden and

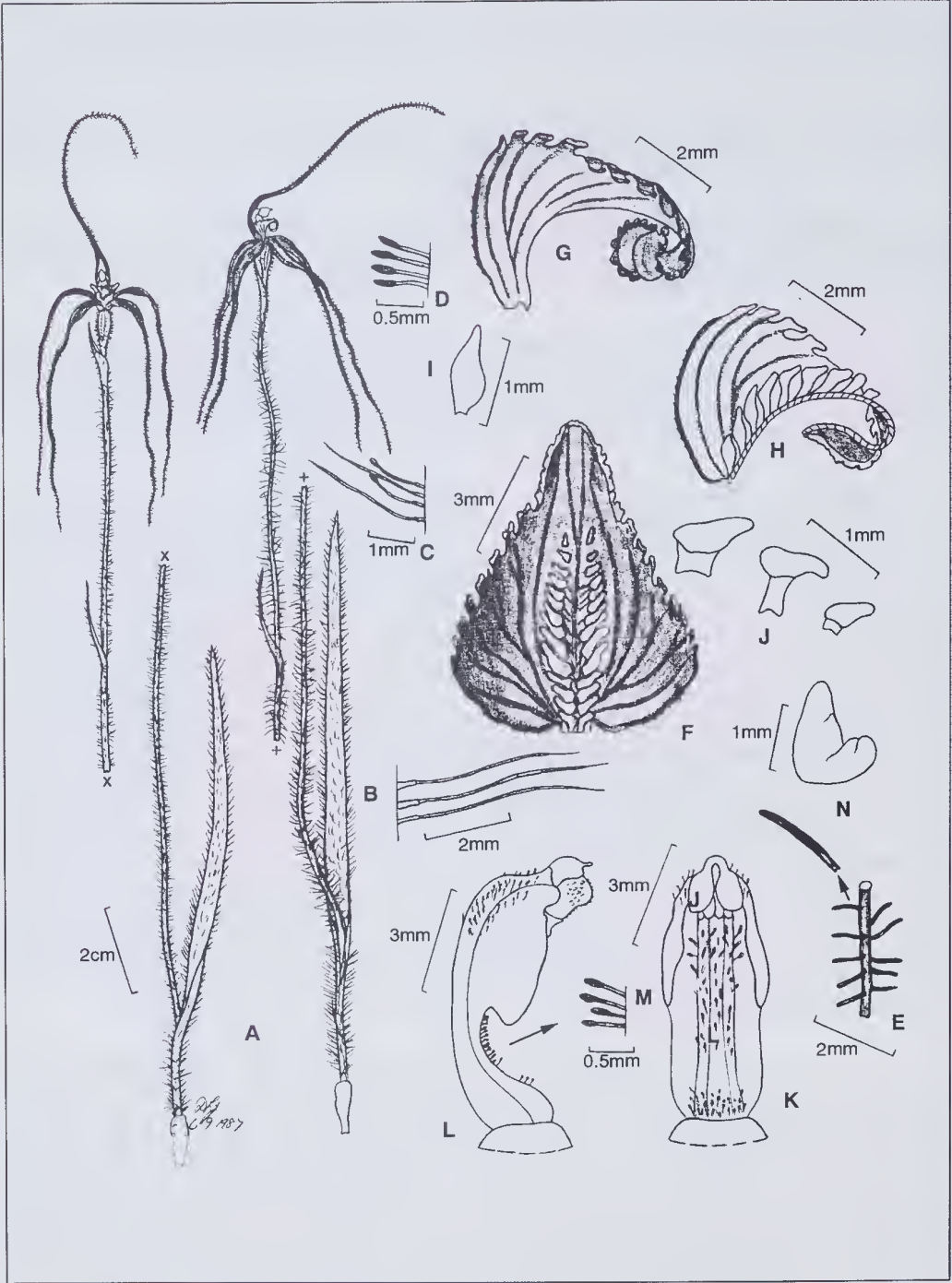


Figure 55. *Caladenia filifera*, R. Heberle s.n. A – plants; B – leaf hairs; C – hairs from upper scape; D – hairs from ovary; E – hairs from tepal apex; F – flattened labellum from above; G – labellum from side; H – longitudinally sectioned labellum from side; I – basal labellum lamina callus; J – labellum lamina calli; K – column from front; L – column from side; M – glandular hairs on column; N – pollinia. Drawn by D.L. Jones.

Wongan Hills, growing in well drained soils under scattered Wandoo and Rock Oak. (Figure 53B)

Flowering period. September to October.

Notes. *Caladenia filifera* has had a chequered taxonomic history. It was described as a species by Lindley in 1840, but was later reduced to a variety of *C. filamentosa* by Reichenbach in 1871. It was considered by various authors (e.g. George 1971; Clements 1982, 1985; Hoffman & Brown 1984) to be a variety of *C. filamentosa* until Jones (1988) reinstated the species to its former rank, a view supported by Clements (1989) and ourselves (e.g. Brown 1989).

Caladenia filifera is allied to *C. dundasiae*, from which it differs in its narrower, longer, more pendulous petals and lateral sepals, its larger uniformly red labellum with central calli extending about one third to a half the length of the lamina, and its later flowering period,

Caladenia filifera resembles *C. pulchra* in having pendulous lateral sepals and petals and a small labellum but differs in its uniform colouration, dark-coloured labellum, usually clumped habit, and more westerly distribution.

There are red-flowered members of the *Caladenia filamentosa* complex collected in South Australia that may be closely allied to *C. filifera* (e.g. Bates & Weber 1990 refer to a Kangaroo Island variant of *C. filamentosa* as having "smaller, glossier, darker-coloured flowers (than the typical variety) and may represent a distinct taxon". Further research, comparing living specimens, is needed to resolve this relationship.

Caladenia footeana* Hopper & A.P. Br., *sp. nov.

A *Caladenia filifera* Lindl. scapis brevioribus petalis sepalisque plus rigide ferentibus hebetibus atromarroninis cremeascentibus ad basin differt.

Typus: Cockleshell Gully on north side of creek, between Jurien Bay Road and Coorow–Greenhead road, 30°09'S, 115°06'E, Western Australia, 17 August 1985, A. P. Brown & S. van Leeuwin 198 (*holo:* PERTH 00900648).

Illustrations. A.S. George & H.E. Foote, *Orchids of Western Australia*, p. 3, bottom left photo (undated); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 45 (1992) and rev. 2nd edn with suppl., p. 45 (1998).

Plant solitary or colonial in small to large clumps. *Leaf* erect, linear, 7–12 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 6.5–22 cm tall. *Flowers* 1 or 2(3), c. 5–8 cm across, dark pinkish red to maroon with cream or maroon lines, spots and blotches; floral odour faint, fetid. *Sepals and petals* stiffly held, dark pinkish-red to maroon becoming creamy-white towards the base, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, 2.5–4 cm x 2–2.5 mm. *Lateral sepals* spreading horizontally then obliquely downwards, often becoming vertical, 3–4 cm x 2–3 mm. *Petals* spreading horizontally, then downcurved to vertical, 2.5–4 cm x 2–2.5 mm. *Labellum* creamy white with prominent pinkish red to maroon radiating basal lines and apical suffusions, stiffly articulate on a claw c. 0.5–1 mm wide; lamina rhomboidal in outline when flattened, 9–12 x 6–8 mm, prominently 3-lobed (rarely obscurely so), erect

with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending margins and calli, distal margins serrate with broadly to narrowly oblique-truncate forward facing pinkish red and sometimes cream marginal calli with apex pinkish red, decrescent towards the apex. *Lamina calli* in 5–12 pairs in 2 rows extending about half the length of the labellum, pinkish-red, sometimes paler proximally, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 6–10 x 3–4 mm, narrowly winged, pinkish red with yellow markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5–2 x 1.5–2 mm, yellow-green and pinkish-red. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 56A–H)

Selected specimens examined. WESTERN AUSTRALIA: 20 km S of Northampton on North West Coastal Highway, 28°31'S, 114°38'E, 22 Aug. 1982, A. Brown s.n. (PERTH 00253553); Oakajee, NW side of Moresby Range, 31 Aug. 1983, R.J. Cranfield 4057 (PERTH 00253154); Russel Rd, Jandakot, 16 Aug. 1959, A.S. George 120 (PERTH 00252190); Helena Valley, c. 4 km downstream from Mundaring Weir, 1 Sep. 1978, A.S. George 15232 (PERTH 00252565); turnoff to Piawaning on the Wongan Hills–Ballidu road, 30°53'S, 116°42'E, 12 Aug. 1983, S.D. Hopper 3124 (PERTH 00321249); 23 km ENE of Wilga Siding, 33°38'S, 116°29'E, 6 Oct. 1983, S.D. Hopper 3471 (PERTH 00321230); 1 km SE of Capercup South Rd on Moodiarrup Rd, 33°35'S, 116°46'E, 11 Sep. 1985, S.D. Hopper 4537 (PERTH 00910732); Cockleshell Gully road crossing, c. 20 km NNE of Jurien, 30°08'S, 115°07'E, 8 Aug. 1986, S.D. Hopper 5186 (PERTH 01709488); SW foot of Totadgin Rock, c. 47 km ENE of Kellerberrin, 31°35'S, 118°12'E, 14 Sep. 1988, S.D. Hopper 6609 (PERTH 01196103).

Distribution and habitat. Occurs in the wheatbelt between Cranbrook and Binnu, extending inland to the Beacon area as rare populations on granite outcrops. Elsewhere, it is usually in Wandoo woodlands on moist clay soils amongst low scattered shrubs and dense annuals. It may also be seen in relatively open seepage areas in otherwise dense shrubland at the northern end of its range. (Figure 53C)

Flowering period. Late July to early October.

Etymology. Named after the late Mr Herb Foote (1910–1987), the driving force behind the foundation of the Western Australian Native Orchid Study and Conservation Group, of which he was President for many years.

Notes. A common and widespread member of the *Caladenia filamentosa* complex. The nearest relative of *C. footeana* appears to be *C. occidentalis*. However, *C. footeana* differs in its shorter, stiffly spreading, uniformly coloured petals and sepals, its pink-tipped calli and its wide distribution off the coast through the wheatbelt.

Caladenia footeana differs from *C. filifera* and *C. pulchra* in its shorter scapes, shorter, more stiffly held petals and sepals which are pinkish-red to maroon in colour, becoming creamy-white towards the base, its shorter more rhomboidal labellum, the lamina often cream with pinkish-red lines and suffusions, and the lamina calli usually pink-tipped. The distributions of the three species overlap near Boyup Brook. However, they rarely grow together.

Caladenia footeana and *C. occidentalis* may be related to typical *C. filamentosa* from Tasmania and allied taxa in Victoria and South Australia. Such relationships require further study.

Caladenia fuscolutescens Hopper & A.P. Br., sp. nov.

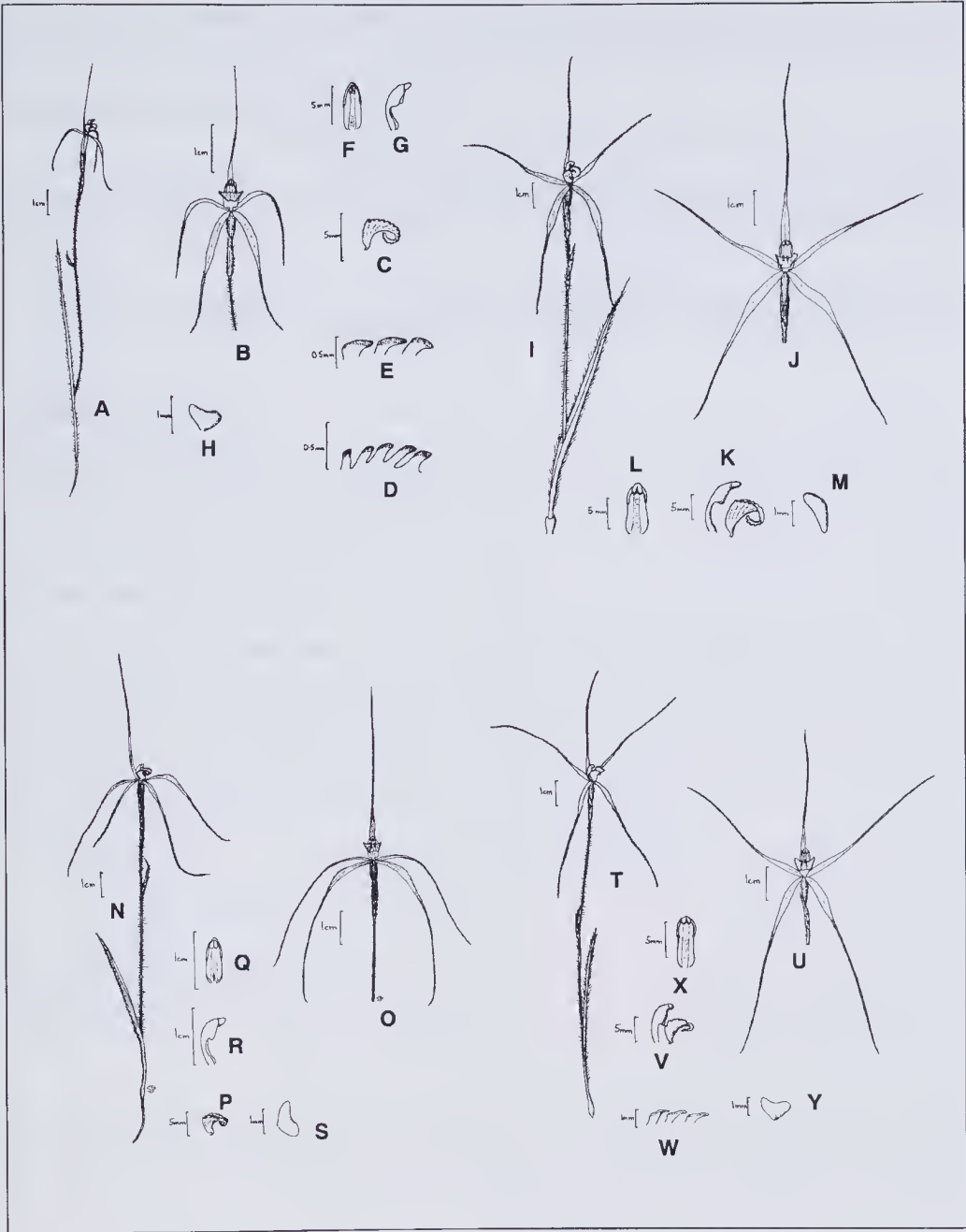


Figure 56 A–H. *Caladenia footeana* from south-west of York, S.D. Hopper 5991. A – plant; B – flower; C – labellum from side; D – labellum fringe; E – calli; F – column from front; G – column from side; H – pollinia. I–M. *C. fuscolutescens* from Hassel National Park, S.D. Hopper 6124. I – plant; J – flower from front; K – labellum and column from side; L – column from front; M – pollinia. N–S. *C. hiemalis* from Goosberry Hill National Park, A.P. Brown 194. N – plant; O – flower from front; P – labellum from side; Q – column from front; R – column from side; S – pollinia. T–Y. *C. horistes* from Pallinup River, S.D. Hopper 6130. T – plant; U – flower from front; V – labellum and column from side; W – labellum lamina calli; X – column from front; Y – pollinia. Drawn by S.J. Patrick.

Caladenia varians subsp. *fuscolutescens* Hopper & A.P. Br. *nom inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 38 (1992).

A *Caladenia vulgata* Hopper & A.P. Br. floribus brunneo-flavidis, apicibus fuscis petalorum sepalorumque et sepalis lateralibus 4.5–8 cm longis, 3–5 mm latis differt.

Typus: estuary at end of Warriup Rd, c. 30 km south of Wellstead, 34°42'S, 118°33'E, Western Australia, 28 September 1987, S.D. Hopper 6121 (*holo*: PERTH 01707000; *iso*: AD, CBG).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 38 [as *Caladenia varians* subsp. *fuscolutescens*] (1992) and rev. 2nd edn with suppl., p. 38 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 7–15 cm x c. 3 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1–3, c. 5–10 cm across, brownish-yellow, with dark brown lines, spots and blotches; floral odour like burning metal. *Sepals and petals* stiffly held near base with a lax apex, linear-lanceolate in basal 1/4–1/3, then abruptly narrowing to a densely glandular dark brown long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–7.5 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 4.5–8 cm x 3–5 mm. *Petals* spreading horizontally, then downcurved to vertical, 4.5–6 cm x 2.5–3 mm. *Labellum* pale brownish yellow with prominent dark brown radiating lines, blotches and markings, stiffly articulate on a claw c. 2 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 12–17 x 8–12 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli, distal margins dentate-serrate with anvil-shaped to triangular forwardly uncinuate pale brownish yellow marginal calli, decrescent towards the apex. *Lamina calli* in 8–14 pairs in 2 rows extending up to half the length of the labellum, pale to dark brownish yellow, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 10–15 x 4–7 mm, narrowly winged, pinkish red to pale yellow with fawn markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2.5 x 2.5 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 3 mm wide. *Capsule* not seen. (Figure 56I–M)

Selected specimens examined. WESTERN AUSTRALIA: 0.5 km S of Two Peoples Bay, SE side of junction of Two Peoples Bay Rd and Sinker Reef Rd, 34°58'S, 118°10'E, 30 Sep. 1983, S.D. Hopper 3410 (PERTH 00277495); Hassell Highway, c. 8 km NE of Warriup Rd, 55 km ENE of King River, 34°38'S, 118°23'E, 28 Sep. 1987, S.D. Hopper 6124 (PERTH 01201417).

Distribution and habitat. A poorly known species apparently restricted to the Green Range–Two Peoples Bay area within 20 km of the south coast. Grows in open tree mallee of Jarrah and *Eucalyptus decipiens*, or in open low woodland of Marri with scattered *Calothamnus* and Christmas Tree. Soils are well-drained sand to sandy loams. (Figure 53D)

Flowering period. Late September to early October.

Etymology. Named from the Latin *fuscus* (a sombre brown) and *lutescens* (becoming yellow), alluding to the floral colouration.

Notes. *Caladenia fuscolutescens* is unusual in its brownish-yellow flowers, prominently striped labellum, and a dark brown apex on the petals and sepals. It is most similar in labellum size to the cream-flowered *C. horistes*, but the latter has less prominent floral markings, a finer threadlike apex on the petals and sepals, and a more easterly distribution.

Caladenia fuscolutescens differs from the common *C. polychroma* in its somewhat smaller consistently brownish-yellow flowers, its sepals and petals stiffly held near the base with alax apex, linear-lanceolate in basal 1/4–1/3, and its preference for well-drained sandy soils in a confined area near the south coast east of Albany.

Caladenia fuscolutescens grows with species such as *Caladenia heberleana*, *C. longicauda*, and *C. pectinata*, but has yet to be found sympatric with any other member of the *C. filamentosa* complex.

Caladenia hiemalis Hopper & A.P. Br., *sp. nov.*

Caladenia varians subsp. *hiemalis* Hopper & A.P. Br. *nom inval.*, in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p31 (1992).

A *C. vulgata* Hopper & A.P. Br. *statura semper brevi, floribus plerumque parvioribus petalis sepalisque rigide ferentibus differt.*

Typus: Gooseberry Hill National Park on first sharp bend at north end of Zig Zag, 31°59'S, 116°04'E, Western Australia, 31 July 1983, S.D. Hopper 3118 (*holo:* PERTH 00269832; *iso:* CBG).

Illustrations. B. Rye, Orchidaceae, in Flora of the Perth Region, p. 808, Figure 297 [as *Caladenia denticulata*] (1987); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 31 [as *Caladenia varians* subsp. *hiemalis*] (1992) and rev. 2nd edn with suppl., p. 31 (1998).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 4–12 cm x c. 3 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1–3, c. 4–7 cm across, cream, with pale maroon lines, spots and blotches; floral odour faint, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/5–1/3, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4–6.5 cm x c. 2 mm. *Lateral sepals* spreading obliquely downwards, 4–6.5 cm x 2–3 mm. *Petals* spreading horizontally, then slightly downcurved, 3.5–6 cm x c. 2 mm. *Labellum* cream with dark maroon radiating basal lines, blotches and markings, stiffly articulate on a claw c. 1 mm wide; lamina narrowly rhomboidal to triangular in outline when flattened, 8–10 x 5–8 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by vertically ascending margins and calli, distal margins dentate-serrate with narrowly anvil-shaped to triangular forwardly uncinat cream to dull maroon marginal calli, apices cream, decrescent towards the apex. *Lamina calli* in 6–12 pairs in 2 rows extending up to half the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 0.5 mm tall, slightly decrescent distally. *Column* 8–10 x 3–4 mm, narrowly winged, pinkish red or cream with fawn to maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2 x 2 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen. (Figure 56N–S)

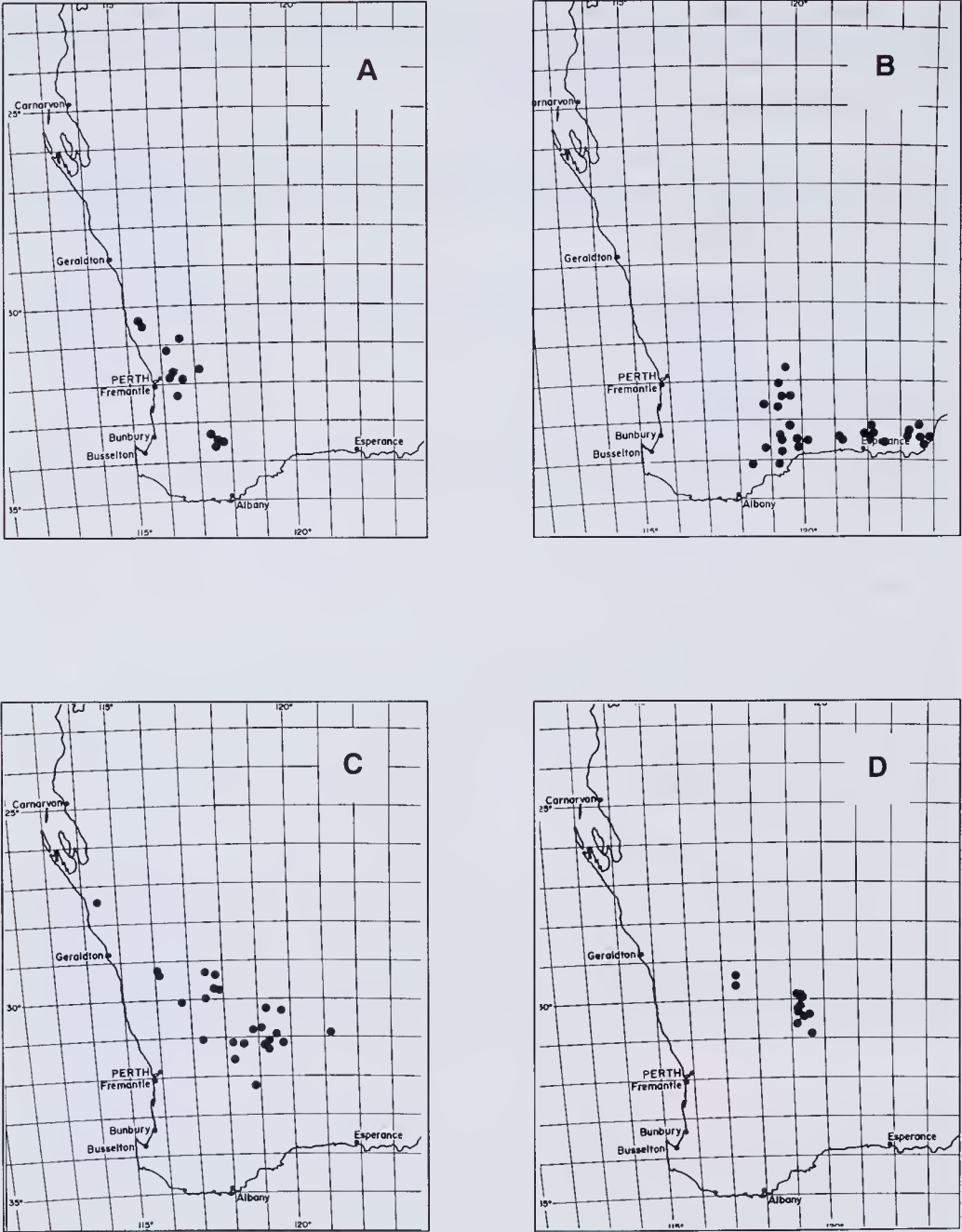


Figure 57. Distribution maps. A – *Caladenia hiemalis*; B – *Choristes*; C – *C. incensa*; D – *C. incrassata*.

Selected specimens examined. WESTERN AUSTRALIA: Brookton Highway opposite first cleared farmland c. 32 km from Kelmscott, 32°13'S, 116°24'E, 14 Aug. 1985, A. Brown 191 (PERTH 00906476); Mission Rd via Cherry Tree Rd, c. 20 km NNE of Kojonup, 33°40'S, 117°45'E, 15 Aug. 1985, A. Brown 194 (PERTH 00906441); Great Eastern Highway c. 55 km W of Kellerberrin, 31°37'S, 117°09'E, 17 Aug. 1988, A. Brown 831 (PERTH 01196669); Zig Zag, Gooseberry Hill, 31°58'S, 116°02'E, 5 Aug. 1980, R.J. Cranfield 1312/80 (PERTH 00269816); 2 km S of Katanning on road at entrance (W side), to hockey oval, 33°43'S, 117°33'E, 25 July 1984, S.D. Hopper 3833 (PERTH 00270229); Broomehill, NE corner of town golf course, 33°51'S, 117°38'E, 25 July 1984, S.D. Hopper 3834 (PERTH 00270237); 98 km N of Perth along Bindoon–Moora road, E slope of Darling Scarp, 31°05'S, 116°03'E, 31 July 1985, S.D. Hopper 4433 (PERTH 00910716); on Talbot West Rd, 8.6 km SE of the Yarra Rd turnoff, 31°58'S, 113°31'E, 8 Sep. 1987, S.D. Hopper 5978 (PERTH 01192450); 1 km W of Kamballup, Woogenillup Rd, to Mount Barker, 4 Aug. 1986, G.J. Keighery 9879 (PERTH 00872598); Wongan Hills, 194 km NE of (Perth, 30°49'S, 116°38'E, 20 July 1974, K.F. Kenneally 1851 (PERTH 01227777).

Distribution and habitat. A locally common species mainly distributed along the western edge of the wheatbelt between Katanning and Beverley, with sporadic occurrences along the edge of the Darling Scarp Perth northwards to Jurien Bay. Grows in Wandoo woodland, often with Rock Oaks, amongst low shrubs and dense herbs in winter-wet clay-loam soil. Flowers best after fire. (Figure 57A)

Flowering period. June to August.

Etymology. Named from the Latin *hiemalis* (belonging to winter, wintry), alluding to the winter flowering period.

Notes. *Caladenia hiemalis* is most similar to *C. exilis*, but differs in its smaller narrower labellum, and its stiffly held and usually shorter petals and sepals. Only one other member of the *C. vulgata* group, *C. meridionalis* flowers in winter, but it is confined to south-coastal heathlands, and has larger flowers with darker apices on the petals and sepals. Rare hybrids of *C. hiemalis* and *C. footeana* have been recorded.

***Caladenia horistes* Hopper & A.P. Br., sp. nov.**

Caladenia varians subsp. *horistes* Hopper & A.P. Br. *nom inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 37 (1992).

A *Caladenia vulgata* Hopper & A.P. Br. folio 4–8 mm lato lateraliter complanato, petalis sepalisque crassiore ferentibus, florescentia medivernali distributione orientali differt.

Typus: Wittenoom Hills, 47 km north-east of Esperance, 33°28'S, 122°08'E, Western Australia, 8 October 1985, S.D. Hopper 4682. (*holo:* PERTH 00910686; *iso:* CBG).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 37 [as *Caladenia varians* subsp. *horistes*] (1992) and rev. 2nd edn with suppl., p. 37 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 4–16 cm x 4–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 14–20 cm tall. *Flowers* 1–3, c. 4–8 cm across, cream to creamy-yellow, with pale brown lines, spots and blotches; floral odour strongly acrid. *Sepals* and

petals stiffly held, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular dark brown long-acuminate finely filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–9 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 4.5–9 cm x 3–4 mm. *Petals* spreading horizontally, then downcurved, 4–8 cm x 2.5–3 mm. *Labellum* cream with yellowish suffusions and pale brown radiating lines, blotches and markings, stiffly articulate on a claw c. 1.5 mm wide; lamina rhomboidal to triangular in outline when flattened, 12–16 x 10–13 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point slightly curved upwards and terminated by scarcely ascending margins and calli, distal margins dentate-serrate with anvil-shaped to triangular forwardly uncinuate creamy yellow marginal calli, decrescent towards the apex. *Lamina calli* in 7–14 pairs in 2 rows extending up to half the length of the labellum, cream to pale brownish yellow, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 12–15 x 5–8 mm, narrowly winged, creamy yellow with fawn markings, sparsely hirsute with short glandular hairs on outer surface. *Ather* c. 2.5 x 2.5 mm, greenish-yellow. *Pollinia* c. 2.5 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 56T–Y)

Selected specimens examined. WESTERN AUSTRALIA: WSW of Israelite Bay on track to Esperance, 33°42'S, 123°40'E, 13 Aug. 1980, A. Brown s.n. (PERTH 00274054); SE side of Mt Ridley, 33°17'S, 122°08'E, 11 Aug. 1980, A.S. George 15969 (PERTH 00267368); Pine Hill, 33°18'S, 123°23'E, 16 Aug. 1980, A.S. George 16111 (PERTH 00263680); Strawberry Rocks, 26 km S of Southern Cross, 31°27'S, 119°17'E, 5 Sep. 1984, S.D. Hopper 4055 (CBG, PERTH 00255122); 75 km E of Narembeen, 17 km ENE of Gibb Rock, 32°05'S, 119°12'E, 5 Sep. 1984, S.D. Hopper 4065 (PERTH 00255114); Pallarup Rock, 44.5 km NNW of Ravensthorpe, 33°15'S, 119°45'E, 6 Sep. 1984, S.D. Hopper 4094a (PERTH 01935151); 100 m N of Pallinup River Bridge on W side of Hassell Rd, 34°25'S, 118°14'E, 6 Oct. 1984, S.D. Hopper 4236 (AD, CBG, CANB, K, MEL, VIC, PERTH 00273155); Wittenoom Hills, 47 km NE of Esperance, 33°28'S, 122°08'E, 8 Oct. 1985, S.D. Hopper 4682 (CBG, PERTH 00910686); Hamersley Inlet, Fitzgerald River National Park, 34°05'S, 119°35'E, 4 Sep. 90, S.D. Hopper 7848 (PERTH 1829955).

Distribution and habitat. Extends from the Boxwood Hills area north to Marvel Loch, and eastwards to Mt Ragged and to Balladonia Roadhouse. Populations grow in damp sandy loams on granite outcrops and along creeklines. Vegetation varies from granitic scrub and open mallee (*Eucalyptus lehmanii*, *Melaleuca uncinata*, *Acacia conniana*), to thickets of Rock Oak and Swamp Yate low woodlands. (Figure 57B)

Flowering period. Late August to September.

Etymology. Named from the Greek *horistes* (one who marks the boundaries), alluding to the geographical position of the species further east and north-east than other large-flowered members of the Western Australian *Caladenia filamentosa* complex.

Notes. *Caladenia horistes* is a consistent taxon throughout its range. It is similar to *C. vulgata*, from which it differs in its stiffly held creamy-yellow sepals and petals, broader labellum, longer column, more easterly distribution and occurrence in seasonally wetter sandy loams. The northern *C. remota* is also allied to *C. horistes*, but *C. remota* differs in its white flowers, shortly serrate more slender marginal labellum calli, lax apices on the petals and sepals, and its taller narrower central labellum lamina calli. *C. fuscolutescens* occurs near the western limits of *C. horistes*, but has brownish-yellow flowers, a more prominently striped labellum, and darker brown apices on the petals and sepals. Yellow-cream variants of *C. polychroma* differ from *C. horistes* in having petals usually ascending, prominent radiating maroon stripes and markings on the labellum, lamina calli uniformly creamy-white, and a

more westerly distribution.

Like many other orchids, *Caladenia horistes* extends well to the east of the wheatbelt and north of Esperance into very dry country by growing in sheltered damp soils on and around granite outcrops. It hybridises occasionally with species such as *C. brevisura* and *C. pachychila*. Eastern populations may grow with *C. microchila*, which has a much smaller labellum and finer more slender sepals and petals.

***Caladenia incensa* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinibus *Caladenia filamentosa* R. Br. folio lato brevi, petalis sepalisque albidis lucentibus, et callis abbreviatis complanatis lucentibus ad apicem differt.

Typus: Chiddarcooping Hill Nature Reserve, near southern boundary, 30°54'S, 118°41'E, Western Australia, 17 August 1988, A. Brown 829 (*holo*: PERTH 01708112; *iso*: AD, CBG, K, MEL, NSW).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), Orchids of Western Australia – cultivation and natural history, colour plate b6 opposite p. 61 [as *Caladenia* species], White Mini Spider Orchid (1989); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 51 (1992) and rev. 2nd edn with suppl., p. 51 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 4–15 cm x 4–15 mm, flattened in cross section, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1 or 2(3), c. 8–14 cm across, bright white with maroon lines, spots and blotches; floral odour pungent, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a yellowish fawn densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 6.5–13 cm x 3–6 mm. *Lateral sepals* spreading outwards, then obliquely downwards, 5–13 cm x 4–6 mm. *Petals* spreading horizontally, then obliquely downcurved, 5–13 cm x 3–5 mm. *Labellum* with prominent pale maroon radiating basal lines often becoming irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1–1.5 mm wide; lamina narrowly triangular to triangular (rarely rhomboidal) in outline when flattened, 11–16 x 10–13 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by slightly ascending margins and calli, distal margins dentate with truncate forwardly uncinuate white marginal calli decrescent towards the apex. *Lamina calli* in 10–16 pairs in 2 rows extending about 2/3–3/4 the length of the labellum, creamy-white with pale pink markings, glossy on top, broadly anvil-shaped, the longest c. 1.5 mm tall, slightly decrescent distally. *Column* 12–15 x 4–6 mm, narrowly winged, opaque white with pale maroon blotches, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2.5 x 2.5 mm, greenish-yellow. *Pollinia* c. 2–2.5 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 58)

Selected specimens examined. WESTERN AUSTRALIA: Koolanooka Hills, 18 km E of Morawa, 29°13'S, 116°13'E, 15 Aug. 1990, G.J. Keighery & J.J. Alford 2020 (PERTH 01668552); Mt Churchman, 29°56'S, 117°54'E, Sep. 1978, S. Charlton s.n. (PERTH 00263702); Duladgin Rock, N of Yellowdine, 31°10'S, 119°41'E, 28 July 1969, A.S. George 9410 (MEL, K, PERTH 00263222); Warradagga Hill, SW of Paynes Find, 29°11'S, 117°30'E, 12 Aug. 1981, S.D. Hopper 1848 (PERTH 00265535); 3 km WNW of Canna, 28°54'S, 115°49'E, 17 Aug. 1983, S.D. Hopper 3133 (CBG, PERTH 00267961); 21 km SW of Nerren Nerren Homestead, 27°15'S, 114°29'E, 23 Aug. 1983, S.D. Hopper

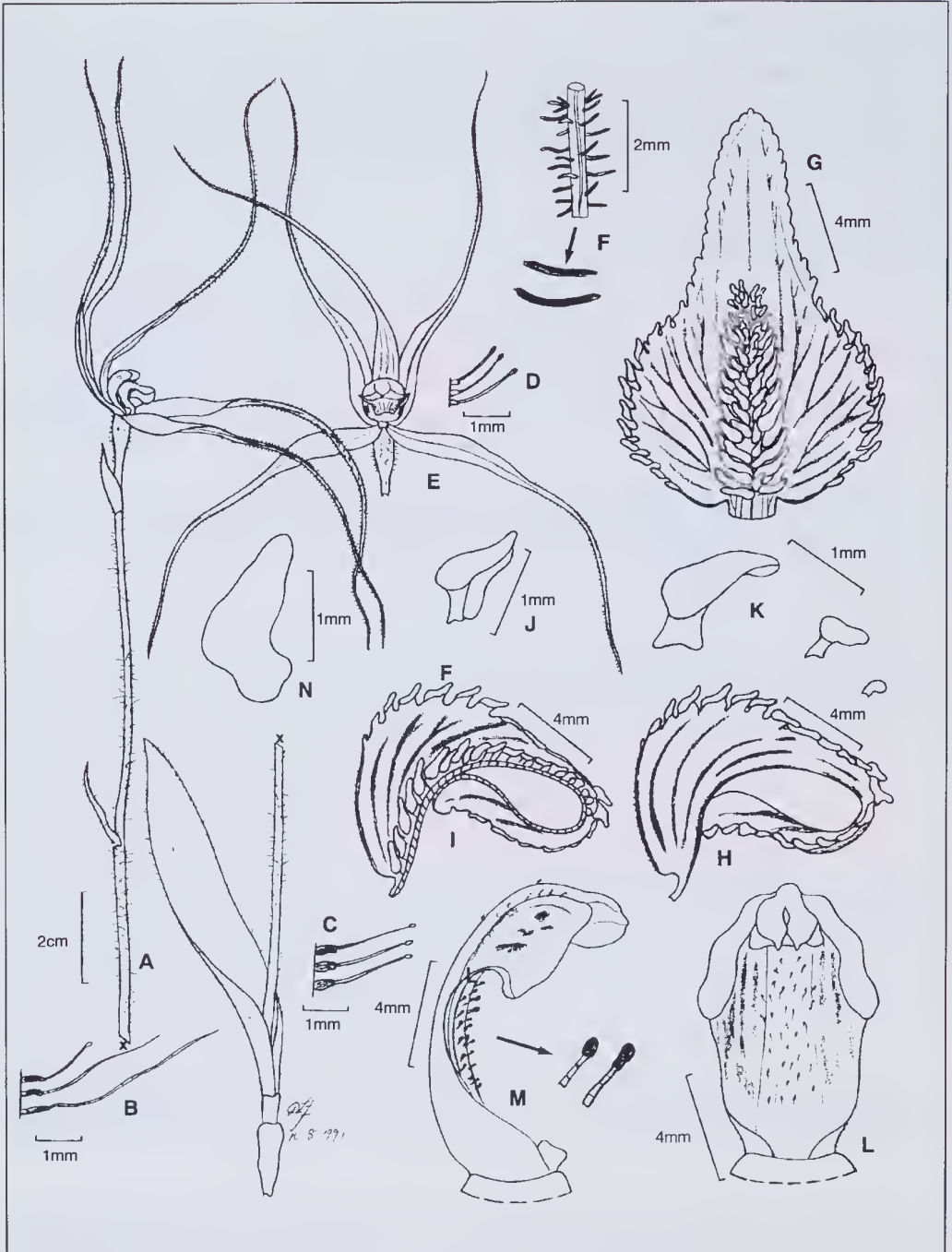


Figure 58. *Caladenia incensa* from Chiddarcooping Hill Nature Reserve, S.D. Hopper 7953. A – plant; B – leaf hairs; C – hairs from lower scape; D – glandular hairs on upper scape; E – flower from front; F – hairs from tepal apex; G – flattened labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J – basal labellum lamina callus; K – labellum lamina calli; L – column from front; M – column from side; N – pollinia. Drawn by D.L. Jones.

3328 (PERTH 00267988); Chiddarcooping Nature Reserve, 30°55'S, 118°41'E, 20 July 1984, *S.D. Hopper* 3817 (CBG, PERTH 00268518); Bungalbin Hill, 49 km N of Koolyanobbing, 30°24'S, 119°38'E, 3 Sep. 1984, *S.D. Hopper* 4029 (PERTH 00268410); Mt Hampton Nature Reserve, 72 km NE of Narembeen, 31°45'S, 119°04'E, 5 Sep. 1984, *S.D. Hopper* 4059 (CBG, PERTH 00268488); Great Northern Highway, c. 18.5 km N of Paynes Find, 29°06'S, 117°43'E, 23 Aug. 1988, *S.D. Hopper* 6508 (PERTH 01698958).

Distribution and habitat. Occurs from east of Hyden to the north of Norseman, north-west through Paynes Find to Eurardy Station on the Great Northern Highway. Plants are commonly seen in seasonally moist soils on or around granite outcrops or along seasonal creeks, and other seasonally moist habitats, usually in open conditions under scattered *Acacia* amongst dense low annuals and perennials. (Figure 57C)

Flowering period. Late June to September.

Etymology. Named from the Latin *incensum* (material that yields a fragrant odour or smoke when burned), alluding to the strong floral odour, like burning metal.

Notes. Distinctive in its strong odour, like burning metal, *Caladenia incensa* is a locally common and widespread species. Together with *C. hirta*, *C. roei* and *C. remota*, *C. incensa* extends well north-east of all other caladenias in Western Australia. There is also a recently discovered taxon closely related to *C. incensa* but with a narrower leaf, pale yellow flowers, and glossy yellow calli that occurs between Southern Cross, Menzies and Coolgardie growing on banded ironstone hills. This taxon extends further east than *C. incensa*.

Apart from this inland taxon, the nearest relative of *Caladenia incensa* appears to be *C. remota*, from which *C. incensa* differs in its shorter broader flattened leaves, and its broad squat calli which are glossy on top. *C. incensa* occasionally hybridises with *C. pachychila* to produce plants resembling *C. x ericksoniae*.

Caladenia incensa has been included, in stylized form, as a central feature of the logo for Westonia Shire.

Caladenia incrassata Hopper & A.P. Br., *sp. nov.*

A *Caladenia doulichiae* O. Sarg. sepalis dorsali plerumque clavo manifeste hinnuleo vel atrobrunneo et labello vitta lata callorum robustorum differt.

Typus: Muddarning Hill, 3 km south-east of Mt Jackson, 69 km north-north-west of Koolyanobbing, 30°15'S, 119°18'E, Western Australia, 1 September 1984, *S.D. Hopper* 4009 (*holo:* PERTH 00240672; *iso:* AD, CBG, K).

Illustrations. D. Jones, Native Orchids of Australia, p. 114 [as *C. doulichiae*] (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 146 [as *Caladenia doulichiae*] (1984), 2nd edn, p. 134 (1992) and rev. 2nd edn with suppl., p. 134 (1998).

Plant solitary or in loose clumps. *Leaf* erect, linear, 10–15 cm x 3–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1, very rarely 2, c. 1–2 cm

across, predominantly yellowish-green, rarely pinkish maroon, with variable suffusions and lines of dull maroon; floral odour absent. *Sepals and petals* stiffly held, the sepals narrowing abruptly to an elongate filamentous apical half; osmophore shortly cylindrical, tumescent, 2–5 mm long in sepals, absent from petals, pink or fawn to yellow, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect to slightly recurved, 1.5–2.0 cm x 1.5–2 mm, linear to slightly tapering in basal 2/3. *Lateral sepals* straight or gently recurved, spreading obliquely downwards, 1.5–2.5 cm x 3–5 mm, basal half narrowly lunate (when flattened) with outer margins recurved in proximal third before flattening at a sharp angular point. *Petals* thrust sharply downward (sometimes obliquely), linear to somewhat tapering, 1.3–1.6 cm x 1.5–2 mm, narrowing to an acute often recurved apex. *Labellum* 3-lobed with a tiny apical midlobe, prominently 2 coloured, yellowish-green to pinkish maroon with red to dark brown radiating stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina laterally oval with a small obtuse apex in outline when flattened, 9–10 x 12–13 mm, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal terminating in the last 2–3 mm in a sharply recurved apex, margins at widest point slightly descending, lateral lobes erect to horizontal with entire margins, midlobe margins entire. *Lamina calli* aggregated in a dense central band band to 2 mm wide extending at least 2/3 the length of the labellum and stopping short of the dark maroon apex, dark purplish maroon with a pale base, erect, linear, capitate with a shiny globular head, the longest c. 2 mm tall, slightly decrescent towards apex. *Column* 10–14 x 6–8 mm, broadly winged, greenish-yellow with prominent maroon suffusion near base. *Anther* c. 2 x 2 mm, yellow-green. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide, yellow-green. *Capsule* not seen. (Figure 59A–G)

Selected specimens examined. WESTERN AUSTRALIA: Pigeon Rocks, c. 100 km NNW of Koolyanobbing, 29°55'S, 119°16'E, 2 Sep. 1984, A. Brown 105 (CBG, PERTH 00929727); Muddarning Hill, E of Mt Jackson, c. 100 km N of Bullfinch, 1 Sep. 1984, A. Brown s.n. (K, PERTH 00237779); Die Hardy Range, 96 km NNW of Koolyanobbing, 29°27'S, 119°24'E, 2 Sep. 1984, S.D. Hopper 4019 (CBG, PERTH 00328928); Bungalbin Hill, 39 km ESE of Mt Jackson, 30°24'S, 119°38'E, 3 Sep. 1984, S.D. Hopper 4030 (CBG, PERTH 00240664); Warrdagga Hill, SW of Paynes Find, 29°23'S, 117°30'E, 21 Aug. 1982, R. Peakall s.n. (PERTH 00929743); Mt Jackson, N of Southern Cross, 4 Sep. 1967, J. Tonkinson s.n.a,b (PERTH 00332798).

Distribution and habitat. Found in scattered localities between Southern Cross, Paynes Find and Perenjori, particularly in the region near Mt Jackson and the Die Hardy range. Its favoured habitat appears to be the southern slopes of ironstone hills under tall *Acacia* (especially *A. quadrimarginea*), *Dryandra arborea* and *Eriostemon*, often in gullies formed by seasonal water courses, but it may also be found in shallow soil pockets on granite outcrops. Soil is red rocky or granitic loam. (Figure 57D)

Flowering period. Late August to September.

Etymology. Named from the Latin *incrassatus* (thickened), alluding to the prominent clubs and thicker calli compared with those of *Caladenia douthiae*.

Notes. A widely scattered but rarely seen species previously included within *Caladenia douthiae*. *C. incrassata* hybridizes with *C. douthiae* along the western edge of its distribution in a narrow strip where the two species overlap.

Caladenia incrassata differs from *C. douthiae* and the related *C. brevisura* in its dorsal sepal with a prominent osmophore, and its occurrence in more north-easterly lower rainfall areas. From

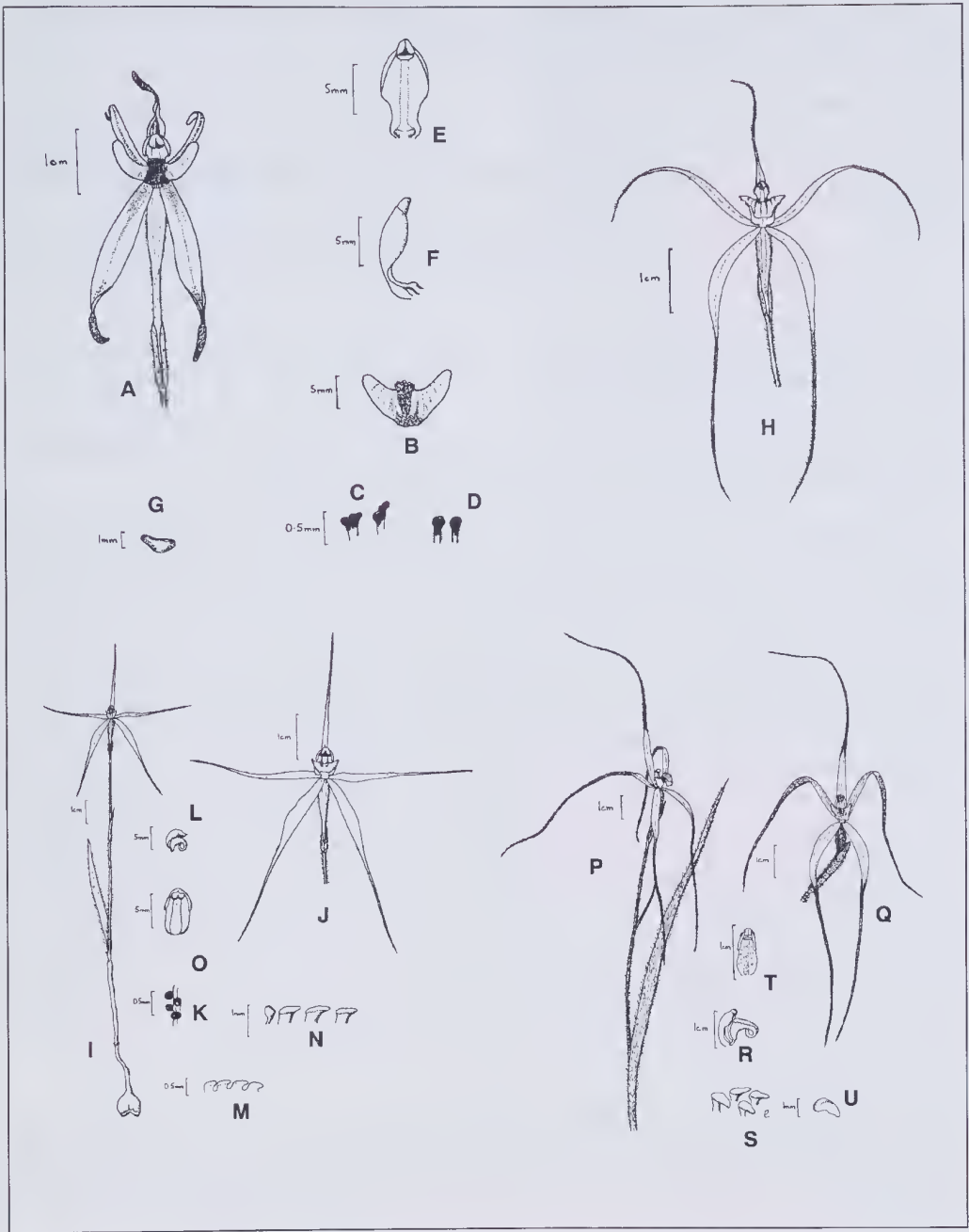


Figure 59 A–G. *Caladenia incrassata* from the Mt Jackson area, S.D. Hopper 4009. A – flower; B – labellum from front; C – calli near rear of labellum; D – calli near front of labellum; E – column from front; F – column from side; G – pollinia. H. – *C. luteola* from the Woodanilling area, S.D. Hopper 4620 H – flower. I–O. *C. melanema* from Lake Altham, S.D. Hopper 4558. I – plant; J – flower from front; K – glands on tips of seals; L – labellum and column from side; M – labellum fringe; N – labellum lamina calli; O – column from front. P–U. *C. meridionalis* from Banksia Flats, south-west of Walpole, W. Jackson s.n. P – plant; Q – flower from front; R – labellum and column from side; S – labellum lamina calli; T – column from front; U – pollinia. Drawn by S.J. Patrick.

C. douthiae, it also differs in its labellum with a broader band of robust taller calli. *C. brevisura* has shorter osmophores on the lateral sepals than *C. incrassata*.

***Caladenia luteola* Hopper & A.P. Br., sp. nov.**

Caladenia caesarea subsp. *subdita* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 56 (1992).

A *Caladenia caesarea* (Domin) M. Clements & Hopper floribus luteis pallidioribus labello recurvato manifeste ad apicem differt.

Typus: 9.7 km west of Woodanilling on Woodanilling West Road, Western Australia, 12 October 1997, S.D. Hopper 5650 (*holo*: PERTH 01071106).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 56 [as *Caladenia caesarea* subsp. *subdita*] (1992) and rev. 2nd edn with suppl., p. 56 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 8–20 cm x 3–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1 or 2, c. 6–9 cm across, lemon yellow to cream with pale to dark maroon to brown stripes and markings; floral odour faint, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/6–1/5, then abruptly narrowing to a dark maroon to brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–7 cm x 2–3 mm. *Lateral sepals* spreading basally then obliquely downcurved, 4.5–7.5 cm x 2.5–5 mm. *Petals* obliquely ascending near base, then downcurved, 4.5–6.5 cm x 2.5–3.5 mm. *Labellum* lemon-yellow to cream with dark maroon to brown stripes and markings to the apex, stiffly articulate on a claw c. 1.5–2 mm wide; lamina triangular to rhomboidal in outline when flattened, 10–20 x 8–11 mm, obscurely 3-lobed, erect with entire margins in basal third, horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated with horizontal to slightly downcurved calli, distal margins with widely spaced serrate to dentate pale yellow with a dark maroon to brown tip, calli decrescent towards the apex. *Lamina calli* in 6–11 pairs in 2 rows extending at least half the length of the labellum, cream, glistening on top, anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally, elongate-oval. *Column* c. 13–15 x 3–6 mm, narrowly winged, creamy yellow to yellow with brown stripes and blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 2–3 x 2–3 mm, yellow or greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 3 mm wide. *Capsule* not seen. (Figure 59H)

Selected specimens examined. WESTERN AUSTRALIA: Reserve number 10147, purpose camping, vesting unknown, Robinson Rd, 9.7 km W of Great Southern Highway, 33°34'S, 117°19'E, 18 Sep. 1992, M.S. Graham s.n. (PERTH 02753693); W of Woodanilling, 12 Oct. 1986, S.D. Hopper 5650 (PERTH); Southfield Rd, W side, c. 2.7 km from Mondalup Rd, c. 250 m W of road, 10 Oct. 95, W. Jackson B.J.365 (PERTH 04354613).

Distribution and habitat. Known only from west of Woodanilling where it grows amongst dense herbs and grasses in a mixed woodland of Wandoo, Rock Oak and Jam, and from the Kalgan River, growing in granitic scrub of *Acacia tryptica*, Yate, *Eucalyptus decipiens* and *Hypocalymma angustifolium*. Soils are rich sandy loams. Photographs taken recently east of Manjimup in a woodland of Wandoo may also be of this species (R. Hearne pers. comm.). (Figure 60A)

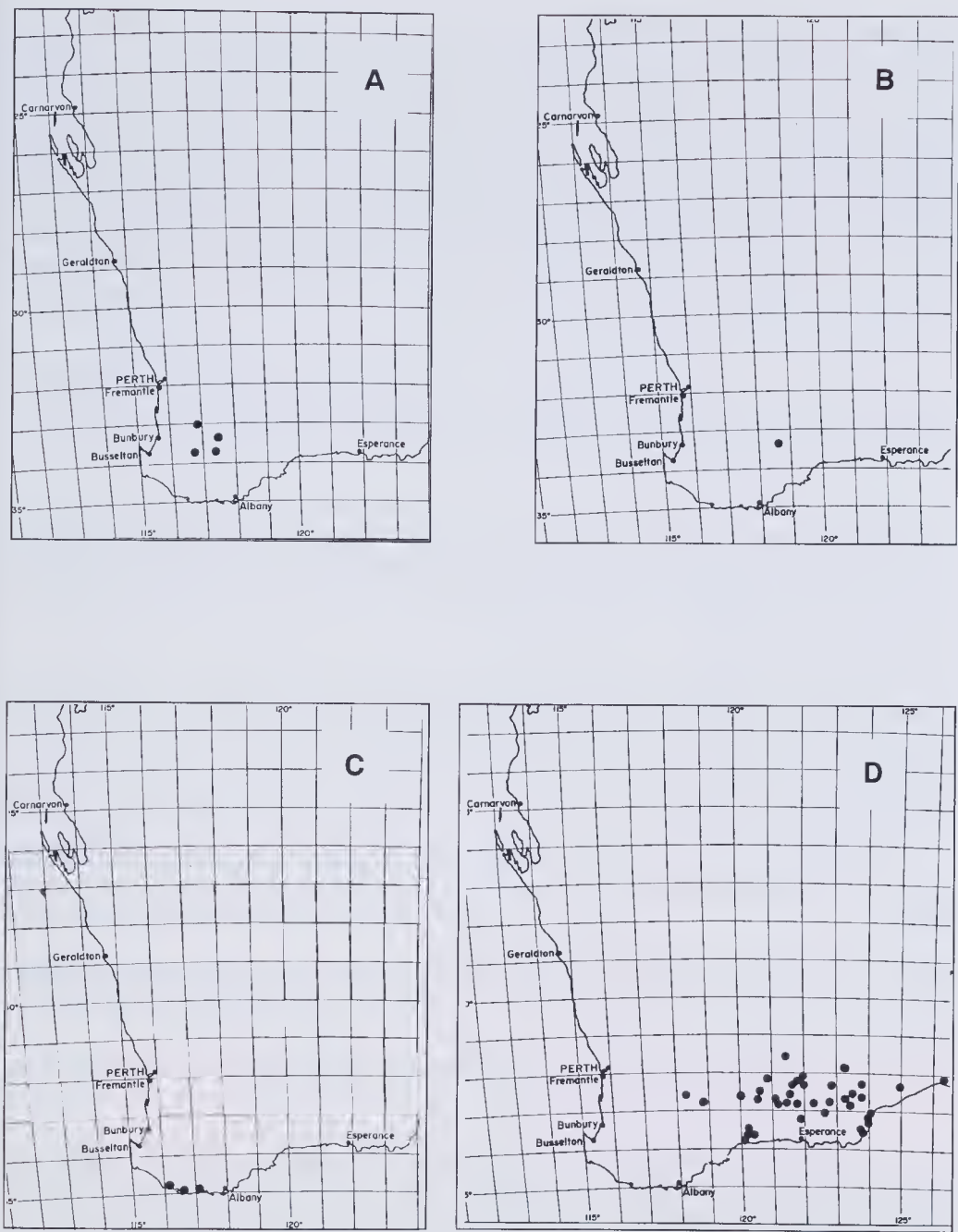


Figure 60. Distribution maps. A – *Caladenia luteola*; B – *C. melanema*; C – *C. meridionalis*; D – *C. microchila*.

Flowering period. September to October.

Etymology. Named from the Latin *luteolus* (pale yellow) alluding to the floral colouration.

Notes. *Caladenia luteola* is a poorly known but apparently rare species (Priority Two) sharing with *C. caesarea*, *C. elegans* and *C. xantha* glistening tops to the labellum lamina calli, and predominantly yellow floral colouration. However, *C. luteola* differs from *C. caesarea* in its paler yellow to cream flowers with narrower less conspicuous stripes and markings on the labellum, and its pale lemon-yellow to cream labellum. From *C. elegans*, *C. luteola* differs in its stiffly held obliquely descending lateral sepal apices, and its lemon-yellow to cream usually longer labellum lamina. *C. luteola* differs from *C. xantha* in its later flowering season, and larger flowers.

Other members of the *Caladenia filamentosa* complex that have yellow flowered variants, such as such *C. polychroma*, *C. dimidia*, *C. ultima*, *C. abbreviata* and *C. denticulata*, differ from *C. luteola* in the dull, non-glistening tops of their labellum lamina calli.

In addition, *Caladenia luteola* has larger flowers than *C. dimidia*, *C. ultima*, and *C. abbreviata*. *C. luteola* also flowers later than *C. dimidia* which grows in close proximity, and flowers earlier than *C. ultima* and *C. abbreviata*, both of which occur further south. *C. luteola* differs from *C. denticulata* in its obliquely descending lateral sepal apices, and its lemon-yellow to cream labellum lamina which is erect in the basal third. And *C. luteola* differs from yellow flowered variants of *C. polychroma* in its shorter broader cream calli.

The population of *Caladenia luteola* west of Woodanilling grows with *C. caesarea* subsp. *caesarea*, and appears to contain hybrids of these two species.

***Caladenia melanema* Hopper & A.P. Br., sp. nov.**

A speciebus aliis affinis *Caladenia filamentosa* R. Br. petalis sepalisque brevibus, albidis ad basin pilis apicum filiformium glandulis hemisphaericis vel breve cylindricis atropurpureis vel nigris differt.

Typus: south of Lake Grace, Western Australia, 12 August 1989, S.D. Hopper 7296 (*holo:* PERTH 01071122; *iso:* CBG).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 28 (1992) and rev. 2nd edn with suppl., p. 28 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 4–12 cm x 2–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 8–15 cm tall. *Flowers* 1 or 2, c. 4–5 cm across, cream to pale yellow (rarely suffused pink or dark red) with dark maroon lines, spots and blotches; floral odour strong, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal quarter, then abruptly narrowing to a dark red-brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs hemispherical. *Dorsal sepal* erect and slightly incurved, 2–4.5 cm x 1.5–2.5 mm. *Lateral sepals* spreading to downcurved, 2–4.5 cm x 1.5–3 mm. *Petals* spreading to downcurved, 2–3 cm x 1.5–3 mm. *Labellum* cream with thick red-maroon radiating basal lines becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina linear-rhomboidal in outline when flattened, 8–11 x 6–8 mm, obscurely 3-lobed,

erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending, distal margins dentate-serrate with white-tipped broad truncate marginal calli decrescent towards the apex. *Lamina calli* in 8–12 pairs in 2 rows extending at least half the length of the labellum, cream occasionally with a maroon apex, anvil-shaped, the longest c. 1 mm tall, decrescent distally. *Column* 9–10 x 3–4 mm, narrowly winged, creamy yellow with red blotches, sparsely hirsute with dark glandular trichomes especially on the central ridge. *Anther* c. 1.5 x 1.5 mm, yellow or greenish-yellow. *Pollinia* c. 1 mm long, yellow. *Stigma* c. 1.5 mm wide. *Capsule* not seen. (Figure 59I–O)

Selected specimen examined. WESTERN AUSTRALIA: S of Lake Grace, 12 Sep. 1985, S.D. Hopper 4558 (PERTH 00909076).

Distribution and habitat. Known only north-north-west of Pingrup, where it grows on sandy clay-loam rises among salt lakes beneath *Eucalyptus spathulata* mallees, *Melaleuca* scrub or thickets and very scattered chenopod low shrubs. (Figure 60B)

Flowering period. August to early September.

Etymology. Named from the Greek *melanos* (black) and *-nema* (thread), alluding to the black filiform apices of the petals and sepals, which are covered in dense black usually hemispherical glandular hairs.

Notes. A poorly known but apparently rare species (Priority Two) considered to be in urgent need of further survey to establish its conservation status. *Caladenia bicalliata*, *C. evanescens* and *C. abbreviata* are all similar to *C. melanema* in having abbreviated petals and sepals, but all are coastal species, whereas *C. melanema* occurs well inland on salt lake margins. *C. melanema* is unique in the *C. filamentosa* complex in its glandular hairs on the petals and sepals usually being hemispherical rather than cylindrical. The only other taxon of the complex that grows near to *C. melanema* is *C. dimidia*, but this differs in its longer petals and sepals (to 8 cm) with cylindrical, not hemispherical glandular hairs, and its variable colouration.

***Caladenia meridionalis* Hopper & A.P. Br., sp. nov.**

Caladenia varians subsp. *merdionalis* Hopper & A.P. Br. *nom. inval.*, in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 39 (1992).

A *Caladenia vulgata* Hopper & A.P. Br. statura semper brevi, folio ad 12 mm lato plus quam dimidio longitudinis scape, petalis sepalisque rigide ferentibus et apicibus fuscis glandulosis differt.

Typus: Cliffy Head, c. 14 km west-south-west of Crystal Springs, 35°01'S, 116°29'E, Western Australia, 31 July 1987, S.D. Hopper 5922 (*holo:* PERTH 01201506; *iso:* CBG).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 39 [as *Caladenia varians* subsp. *merdionalis*] (1992) and rev. 2nd edn with suppl., p. 39 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 10–13 cm x 4–12 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–20 cm tall. *Flowers* 1 or 2, c. 6–10 cm across, cream to rarely pale yellow, with dark maroon lines, spots and blotches; floral odour strongly sweet. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a densely

glandular dark red-brown long-acuminate finely filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5.5–8 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 5.5–8 cm x 2–4 mm. *Petals* spreading obliquely upwards or horizontally and then downcurved, 5–7 cm x 2–3 mm. *Labellum* cream with dark maroon radiating lines, blotches and markings, stiffly articulate on a claw c. 1.5 mm wide; lamina rhomboidal in outline when flattened, 12–17 x 6–10 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point slightly curved upwards and terminated by scarcely ascending calli, distal margins serrate-dentate with anvil-shaped to triangular forwardly uncinuate creamy yellow maroon-marked marginal calli, decrescent towards the apex. *Lamina calli* in 6–12 pairs in 2 rows extending up to a third the length of the labellum, creamy-yellow with pink-maroon markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 7–10 x 4–6 mm, narrowly winged, creamy yellow with maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 59P–U)

Selected specimens examined. WESTERN AUSTRALIA: Windy Harbour, 34°50'S, 116°02'E, Aug. 1984, G. Gardner s.n. (PERTH 00277487); Quarram Nature Reserve, 1 km W of Parry Inlet Beach, 35°03'S, 117°10'E, 7 Oct. 1984, S.D. Hopper 4258 (PERTH 00266930); W side of Mandalay Beach Rd, c. 16.7 km SW from the Ranger's house, in Walpole National Park, 34°59'S, 116°33'E, 16 Oct. 1986, S.D. Hopper 5740 (PERTH 01669621); on Banksia Track, c. 10 km WSW of Crystal Springs, Walpole-Nornalup National Park, 35°00'S, 116°31'E, 30 July 1987, S.D. Hopper 5912 (PERTH 01201492).

Distribution and habitat. A rare species restricted to consolidated coastal dunes in the Walpole–Windy Harbour area on the extreme south coast. Grows in low coastal heath, sometimes with scattered stunted emergent trees of Peppermint, banksias, and Yate. (Figure 60C)

Flowering period. June to early August.

Etymology. Named from the Latin *meridionalis* (south, southern), alluding to the geographical distribution of the species.

Notes. *Caladenia meridionalis* differs from *C. vulgata*, with which it grows, in its consistently short stature, broad leaf, stiffly held petals and sepals with a dark apex, short column and earlier flowering period. *C. hiemalis* also flowers in winter, but *C. meridionalis* differs from it in having a broader leaf, larger flowers, a darker apex to the petals and sepals, and a sweet floral odour, as well as a more southerly distribution.

The time at which *Caladenia meridionalis* flowers is especially remarkable given its confinement to the higher rainfall south coast area near Walpole, where most caladenias flower later rather than earlier than their northern counterparts.

***Caladenia microchila* Hopper & A.P. Br., sp. nov.**

A *Caladenia paradoxa* Hopper et A.P. Brown floribus brevioribus semper cremeis, petalis rigide ascendentibus, sepalis lateralibus 4.5–7 cm longis, 2–2.5 mm latis, labello 4–6.5 mm longo, 4–5 mm latis differt.

Typus: south side of Mt Coobaninya, 79 km south-west of Balladonia, 33°01'S, 123°21'E, Western

Australia, 22 August 1989, *S.D. Hopper* 7412 (*holo*: PERTH 02648725; *iso*: AD, CBG, K, MEL).

Illustrations. W. Nicholls, *Orchids of Australia*, plate 258e [as *Caladenia filamentosa* var. *tentaculata*] (1969); K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia - cultivation and natural history*, colour plate c7 opposite p. 61 [as *Caladenia filamentosa* var. *tentaculata* 'Wispy Spider Orchid'] (1989); R. Bates & J. Weber, *Orchids of South Australia*, plate 43 [as *Caladenia filamentosa* var. *tentaculata*] (1990); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 78 [as *Caladenia filamentosa* var. *tentaculata*] (1984), 2nd edn, p. 49 (1992) and rev. 2nd edn with suppl., p. 49 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 8–16 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 9–25 cm tall. *Flowers* 1–3, c. 3–6 cm across, cream with maroon stripes and blotches; floral odour strong, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3.5–7 cm x 1.5–2 mm. *Lateral sepals* spreading obliquely downwards, 4.5–7 cm x 2–3 mm. *Petals* spreading somewhat above horizontal, 2.5–6 cm x 1.5–2 mm. *Labellum* cream with dull maroon radiating basal lines becoming blotches and markings, stiffly articulate on a claw c. 1 mm wide; lamina narrowly triangular in outline when flattened, 4–6.5 x 4–5 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending margins and calli, distal margins dentate with broadly truncate to triangular forwardly uncinate cream marginal calli, decrescent towards the apex. *Lamina calli* in 6–10 pairs in 2 rows extending about half the length of the labellum, cream to cream with red-pink markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 5–7 x 3–4 mm, narrowly winged, pinkish red or cream with fawn markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.0–1.5 x 1.0–1.5 mm, greenish-yellow. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 1.5 mm wide. *Capsule* not seen. (Figure 61A–F)

Selected specimens examined. WESTERN AUSTRALIA: Peak Eleanor, Oct. 1984, *M.A. Burgman* 4630 (PERTH 00241571); 14.3 km E of Fields Rd on Peak Charles Rd, 32°56'S, 121°16'E, 7 Sep. 1983, *M.A. Burgman* & *S. McNee* 2250 (PERTH 00251666); Via Baxter's Memorial Track, 32.5 km S of Caiguna, 24 Aug. 1983, *M.J. Fitzgerald* B.39 (PERTH 00252638); Ravensthorpe Range, 33°35'S, 120°08'E, 10 Sep. 1971, *A.S. George* 10979 (PERTH 00252166); 7 km W of Israelite Bay, 33°38'S, 123°48'E, 14 Aug. 1980, *A.S. George* 16011 (PERTH 00251631); 1.8 km S of Varley crossroads on road to Purnta Rock, 32°49'S, 119°01'E, 6 Sep. 1984, *S.D. Hopper* 4089 (AD, CBG, K, MEL, PERTH 00245402); c. 70 km SSW of Balladonia on southern edge of large salt lake, 32°50'S, 123°10'E, 22 Aug. 1989, *S.D. Hopper* 7403 (PERTH 1829807); Hamersley Inlet, Fitzgerald River National Park, 34°05'S, 119°35'E, 4 Sep. 90, *S.D. Hopper* 7846 (PERTH 1829939); Telegraph Pass, Hampton Scarp, 24 km SE of Cocklebidy (Nuytsland Nature Reserve), 32°10'S, 126°18'E, 5 Oct. 1987, *K.R. Newbey* 11758 (PERTH 00849405); c. 70 km NE of Norseman, 9 Aug. 1980, *K.R. Newbey* 6974 (PERTH 00252107).

Distribution and habitat. A widespread species occurring in Western Australia from Newdegate and the Fitzgerald River National Park eastwards to at least Madura on the southern Nullarbor Plain. Grows along limestone escarpments of the southern Nullarbor, but further west it grows in a range of loamy soils under mallee eucalypts or in woodlands of Gimlet (*Eucalyptus salubris*). Occasionally it occurs on granite outcrops, ironstone hills, or sandy soils around salt lakes. Extends into South Australia, where it may be common on calcareous soils, and possibly also into adjacent areas of Victoria and New

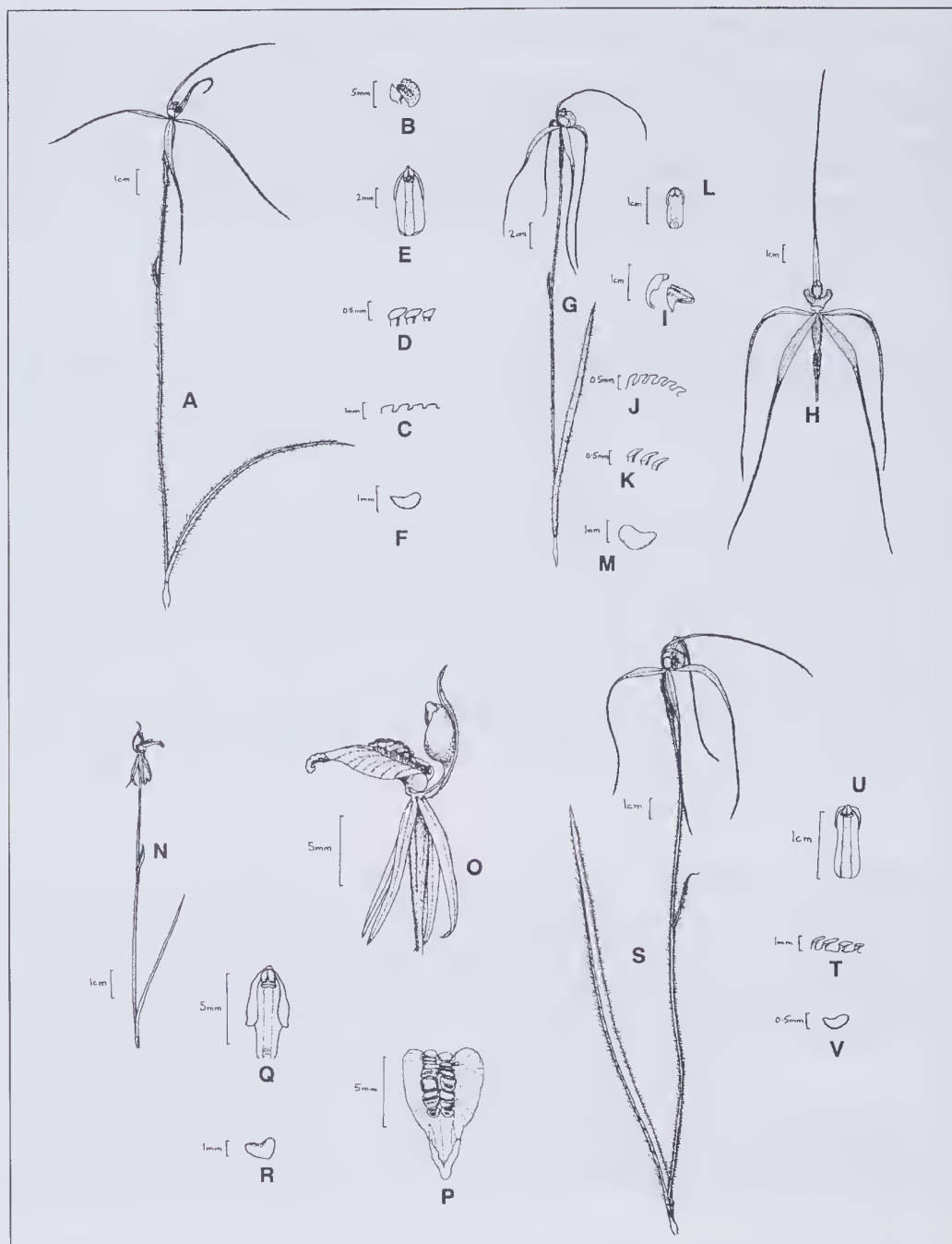


Figure 61 A–F. *Caladenia microchila* from Fank Ilann National Park, A.P. Brown s.n. A – plant; B – labellum from side; C – labellum fringe; D – labellum lamina calli; E – column from front; F – pollinia. G–M. *C. nobilis* from Yalgorup National Park, S.D. Hopper 4150. G – plant; H – flower from front; I – labellum and column from side; J – labellum fringe; K – labellum lamina calli; L – column from front; M – pollinia. N–R. *C. pachychila* from the Merredin area, A.P. Brown 676. N – plant; O – flower from side; P – labellum; Q – column from front; R – pollinia. S–V. *C. pendens* subsp. *pendens* from Camel Peaks, Hyden area, S.D. Hopper 4577. S – plant; T – labellum lamina calli; U – column from front; V – pollinia. Drawn by S.J. Patrick.

South Wales. (Figure 60D)

Flowering period. August to September.

Etymology. Named from the Greek *micro* (little, small) and *-cheilo* (lip), alluding to the labellum which is the smallest among Western Australian (and possibly all Australian) *Caladenia* species with filamentous sepals and petals.

Notes. *Caladenia microchila* in Western Australia is a common orchid of the semi-arid south-eastern wheatbelt and adjacent lands, and extends in a narrow band of disjunct populations across the limestone cliffs of the southern Nullarbor. It is readily distinguished from all other members of the Western Australia *C. filamentosa* complex by its very small labellum, the nearest species in size being *C. paradoxa*. However, *C. microchila* differs from *C. paradoxa* in its smaller consistently cream flowers with petals stiffly upsept, and its narrower labellum 4–5 mm wide.

Specimens from South Australia appear to vary from those mainly matching *Caladenia microchila* to others close to *C. paradoxa*. Field inspections of living populations are needed to resolve this variation and correctly determine all herbarium specimens. Resolution of this problem is one for future research. It is also possible that plants in Victoria and New South Wales are *C. microchila*, but we have been unable to compare living specimens with typical Western Australian plants. Further studies are needed.

***Caladenia nobilis* Hopper & A.P. Br., sp. nov.**

Caladenia varians subsp. *nobilis* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 35 (1992).

A *Caladenia vulgata* Hopper & A.P. Br. floribus plerumque majoribus et labello majore plus late sagittato differt; a *C. chapmanii* Hopper & A.P. Br. floribus semper albidis maculatis rubris et statura brevior.

Typus: Yalgorup National Park, 6 km west of Mandurah-Bunbury rd on Preston Beach Rd, 32°54'S 115°02'E, Western Australia, 12 September 1984, S.D. Hopper 4150 (*holo:* PERTH 00265942; *iso:* AD, CBG, K).

Illustrations. M. Pocock, Ground Orchids of Australia, photo 20 [as *Caladenia filamentosa* var. *tentaculata*] (1972); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 35 [as *Caladenia varians* subsp. *nobilis*] (1992) and rev. 2nd edn with suppl., p. 35 (1998).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 10–18 cm x c. 4–8 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1–3, c. 10–13 cm across, cream, with pale maroon lines, spots and blotches; floral odour sometimes faint, like burning metal to putrid. *Sepals and petals* stiffly held near base with a lax apex, linear-lanceolate in basal 1/6–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 6–15 cm x 2.5–4 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 6–15 cm x 3–6 mm. *Petals* spreading horizontally, then downcurved to vertical, 6–14 cm x 2.5–4 mm. *Labellum* cream with dark maroon radiating basal lines, blotches and markings, stiffly articulate on a claw

c. 2 mm wide; lamina rhomboidal to triangular in outline when flattened, 12–25 x 12–16 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins serrate, rarely dentate, with narrowly anvil-shaped to triangular forwardly uncinat cream to dull maroon marginal calli with tip cream, decrescent towards the apex. *Lamina calli* in 8–18 pairs in 2 rows extending up to 2/3 the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 2 mm tall, slightly decrescent distally. *Column* 13–18 x 5–10 mm, narrowly winged, pinkish red or cream with fawn to maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2.5–4 x 2.5–4 mm, greenish-yellow. *Pollinia* c. 2.5–3 mm long, yellow. *Stigma* c. 2.5–4 mm wide. *Capsule* not seen. (Figure 61G–M)

Selected specimens examined. WESTERN AUSTRALIA: Well Siding Rd, c. 20 km N of Northampton near North West Coastal Highway, 28°11'S, 114°38'E, 18 Aug. 1985, A. Brown & S. van Leeuwen 205 (PERTH 00930164); Hawks Head road just before lookout, c. 3.3 km from Ajana–Kalbarri road, in Kalbarri National Park, 27°48'S, 114°29'E, 21 Aug. 1985, A. Brown & S. van Leeuwen 218b (PERTH 00901229); just NE of junction of Thomas Rd and Johnson Rd, E of Medina, 32°14'S, 115°51'E, 18 Sep. 1977, A.S. George s.n. (PERTH 00265454); c. 14 km NNE of Dongara; 1.1 km S of Mt Horner West Rd along Water Supply road, 25 Aug. 1983, S.D. Hopper 3359 (CBG, PERTH 00274127); 18 km SW of Mingenew, along Yandandooka West Rd, 29°20'S, 115°22'E, 25 Sep. 1983, S.D. Hopper 3369 (AD, CBG, PERTH 00266868); 5 km S of Preston Beach Road on Mandurah–Bunbury Rd, 33°00'S, 115°44'E, 12 Sep. 1984, S.D. Hopper 4138 (AD, CBG, K, PERTH 00265519); N side of Beermullah West Rd, NW of Gingin, 31°14'S, 115°42'E, 18 Sep. 1987, S.D. Hopper 6078 (PERTH 01201441).

Distribution and habitat. Occurs on the Swan Coastal Plain between Australind and Gingin, and in the Mingenew to Kalbarri region further north. Coastal Plain populations south of Perth occur in Tuart and Peppermint woodland on calcareous sands. West of Gingin populations occur on rises adjacent to swamps in sandy clay soil. Near Mingenew, sheoak (*Allocasuarina*) woodlands on deep sand are favoured. Near Ajana and Binu the species grows in heavier red clay-loam soils in York Gum and Jam woodland, or scrub of Jam, *Hakea recurva*, and *Acacia tetragonophylla*. Near the coast south of Kalbarri low heath on sandstone is occupied. (Figure 62A)

Flowering period. August to early October.

Etymology. Named from the Latin *nobilis* (noble, excellent), alluding to the large flowers of the species.

Notes. *Caladenia nobilis* grows with *C. vulgata* but differs in its generally larger flowers with a broader labellum, larger taller central calli in up to 18 pairs extending to two-thirds the length of the lamina, and its larger column. *C. nobilis* is the largest white-flowered member of the Western Australian *C. filamentosa* complex. *Lateral sepals* are up to 15 cm long and the labellum may attain dimensions of 25 x 16 mm. Very large specimens of *C. pendens* overlap small *C. nobilis* in flower size, but have a narrower labellum.

Caladenia nobilis has at least three geographical races that show insufficient morphological differentiation to be recognized as separate subspecies, but each occupies a distinctive habitat. The race favouring sandy soils near Mingenew is perhaps the most distinctive, with lax petals and sepals,

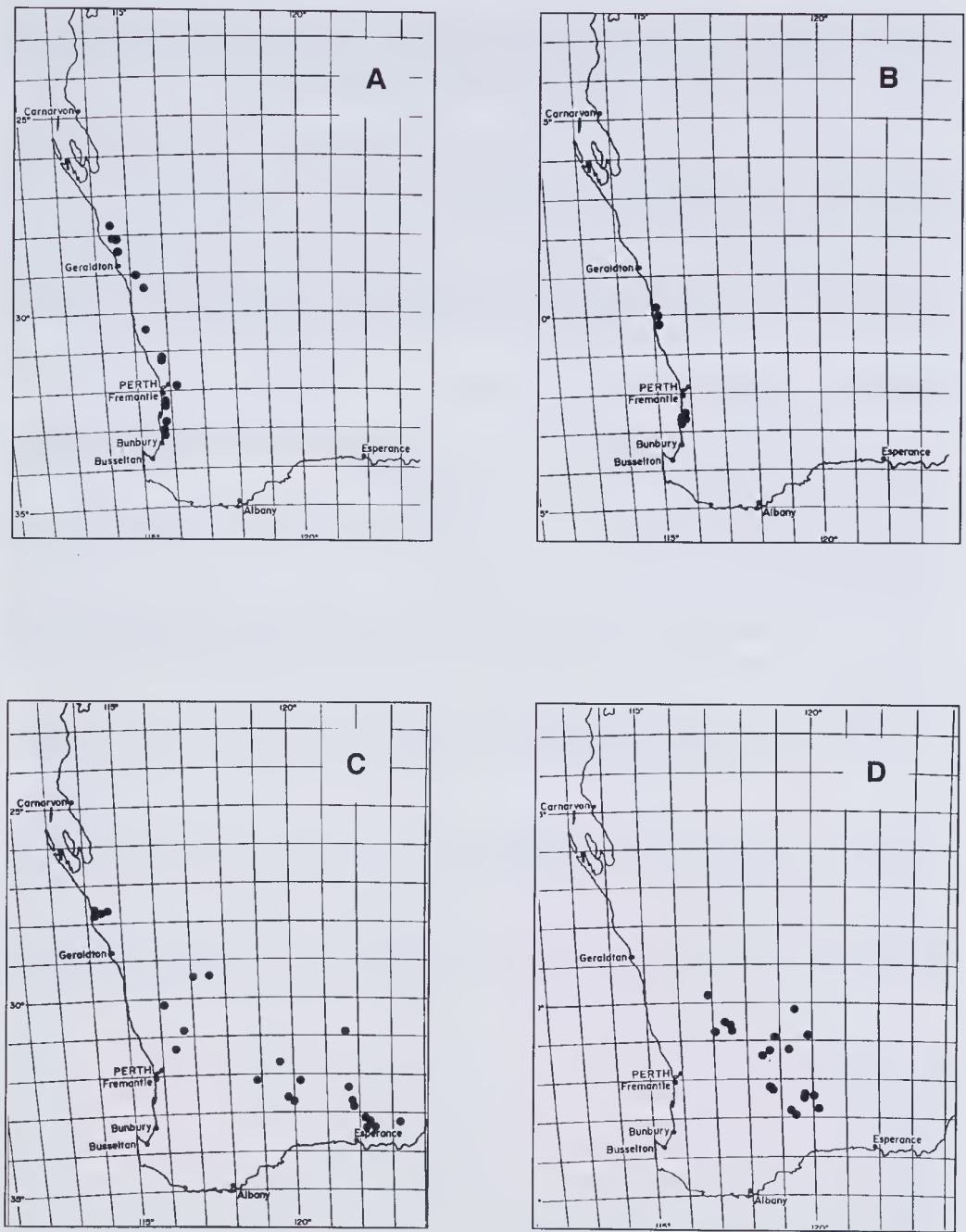


Figure 62. Distribution maps. A – *Caladenia nobilis*; B – *C. occidentalis*; C – *C. pachychila*; D – *C. paradoxa*.

the lateral sepals often having crenulate basal margins, and the labellum noticeably flattened towards the rear. It occurs as solitary or few-flowered clumps. Populations in swamps west of Gingin may belong to this race, but further study of them and intervening populations are needed.

The northern race occupying heavy soils has stiffer sepals and petals, and is noticeably colonial, often forming extensive populations in good seasons. Occasional red individuals of this race may be the result of hybridisation with *Caladenia footeana*.

The southern coastal plain race on calcareous soils grows as solitary or few-flowered clumps, and has stiffly downswep petals and sepals. These populations occasionally hybridize with *Caladenia vulgata*, and plants with reddish markings may be rare hybrids with *C. occidentalis*.

***Caladenia occidentalis* Hopper & A.P. Br., sp. nov.**

Caladenia variegata Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 44 (1992), *nom. illeg non* Colenso (1885).

A *Caladenia footeana* Hopper & A.P. Br. floribus pallidioribus majoribus in scapis elatioribus et callis albidis differt.

Typus: 300 m east of Mandurah–Fremantle road on Paganoni Rd, 12 km north-north-east of Mandurah, 32°26'S, 115°47'E, Western Australia, 12 September 1984, S.D. Hopper 4137 (*holo*: PERTH 00321214; *iso*: AD, CBG).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 44 [as *Caladenia variegata*] (1992) and rev. 2nd edn with suppl., p. 44 (1998).

Plant solitary or colonial in small to large clumps. *Leaf* erect, linear, 10–15 cm x 3–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1 or 2(3), c. 5–7 cm across, pale pinkish-red, rarely maroon; floral odour strong, fetid. *Sepals and petals* stiffly held, pale pinkish-red, rarely cream or maroon, becoming creamy-white towards the base, linear-lanceolate in basal quarter, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect, 4–6 cm x 2–2.5 mm. *Lateral sepals* spreading horizontally then obliquely downwards, often becoming vertical, 4–6 cm x 2.5–3 mm. *Petals* spreading horizontally, then downcurved to vertical, 3.5–5 cm x 2–2.5 mm. *Labellum* creamy white with faint pinkish red to maroon radiating basal stripes and apical blotches and suffusions, stiffly articulate on a claw c. 1 mm wide; lamina rhomboidal in outline when flattened, 8–12 x 6–9 mm, prominently 3-lobed (rarely obscurely so), erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending calli, distal margins serrate to dentate with broadly oblique-truncate forward facing pinkish red and sometimes cream marginal calli with tip pinkish red to cream, decrescent towards the apex. *Lamina calli* in 8–18 pairs in 2 rows extending about 1/2–2/3 the length of the labellum, cream to pinkish-red, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 8–12 x 3–5 mm, narrowly winged, cream with pinkish red markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, yellow-green and pinkish-red. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: Arro Flats, NW of Eneabba, 19.08.1993, A.P. Brown 1041 (PERTH); 4.1 km W of Mandurah–Bunbury road on Preston Beach Rd, 32°54'S, 115°12'E, 12 Sep. 1984, S.D. Hopper 4146 (PERTH 00253561); 37.3 km S of Mandurah on the Old Coast Rd, 32°50'S, 115°41'E, 9 Sep. 1985, S.D. Hopper 4491 (PERTH 00908606).

Distribution and habitat. Geographically restricted and of disjunct occurrence, from south of Mandurah to near Perth and between Lake Indoon and Dongara. Near Perth it grows in coastal Tuart, *Banksia*, Peppermint woodland in well drained calcareous sand, while in the Lake Indoon–Dongara area it grows under *Casuarina obesa* and Flooded Gum adjacent to partially saline shallow lakes. Soils in southern populations are yellow-brown calcareous sands with outcropping limestone, while northern populations occupy winter-wet sandy-clay. (Figure 62B)

Flowering period. August to October.

Etymology. Named from the Latin *occidentalis* (western), alluding to its distribution along the west coast of Australia.

Notes. *Caladenia occidentalis* may be related to *C. footeana*, but differs notably in its longer petals and sepals, less uniform colouration, its paler calli and its confinement to near-coastal areas between Dongara and Bunbury. Both these species may also be related to typical *C. filamentosa* from Tasmania, and allied taxa from Victoria and South Australia. Further research on this possible connection between western and eastern Australia is needed.

Caladenia occidentalis is known from a site in Yalgorup National Park where it hybridises freely with *C. vulgata*. At this site, the two species are readily distinguished on floral coloration.

***Caladenia pachychila* Hopper & A.P. Br., sp. nov.**

A *Caladenia cairnsiana* F. Muell. caulibus brevioribus, floribus minoribus, petalis sepalisque a caule deorsum et extrorsum patentibus, labello horizontali callo terminali crassissimo praedito differt.

Typus: 2.1 km north-west along Salmon Gums–Norseman highway from Caltex Garage, Salmon Gums, 32°58'S, 121°37'E, Western Australia, 6 September 1982, S.D. Hopper 2505 (*holo:* PERTH 00250600; *iso:* CBG).

Illustrations. W. Nicholls, *Orchids of Australia*, Plate 235 f, i, j (1969); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 140 [as *Caladenia cairnsiana* 'wheatbelt form'] (1984), 2nd edn, p. 131 (1992) and rev. 2nd edn with suppl., p. 49 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 5–12 cm x c. 5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 8–20 cm tall. *Flowers* 1(2), c. 1 cm across, cream to greenish yellow with pale maroon stripes and markings; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate, shortly constricted at apex, sparsely glandular adaxially, lacking a tumescent osmophore; glandular hairs elongate, cylindrical, capitate. *Dorsal sepal* erect and slightly incurved, 1–1.5 cm x 1.5–3 mm. *Lateral sepals* thrust downwards somewhat obliquely off vertical away from ovary with apex slightly incurved, 1–1.5 cm x 1.5–4 mm. *Petals* thrust downwards somewhat obliquely off vertical away from ovary with apex slightly incurved, 0.8–1.5 cm x 1–2 mm. *Labellum* cream to greenish-yellow with thin pale maroon radiating stripes, stiffly articulate and held obliquely upwards below 45

° on a claw c. 1.5 mm wide; lamina triangular with rounded entire margins in outline when flattened, 8–12 x 7–10 mm, 3-lobed, slightly ascending with downcurved margins over entire length, terminating in a noticeably thickened red-maroon V-shaped apical callus 2–3 mm long. *Lamina calli* in 6–10 pairs in 2 rows or congested into one extending up to half the length of the labellum, capitate with a cream base and a dark maroon irregularly swollen shiny tip, the longest c. 1 mm tall. *Column* c. 8–10 x 4–8 mm, broadly winged, translucent fawn with pale maroon markings. *Anther* c. 2–2.5 x 2–2.5 mm, yellow, greenish-yellow or pale maroon. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 61N–R)

Selected specimens examined. WESTERN AUSTRALIA: c. 1 km S of Digger Rocks on Hatters Hill–Digger Rocks road, 32°44'S, 119°52'E, 30 Aug. 1986, A. Brown 357 (PERTH 00929719); Kalbarri, SE of town, just off Porter St, 27°43'S, 114°11'E, 20 Aug. 1985, A. Brown & S. van Leeuwen 212 (PERTH 00843792); Hawkshead Rd just before lookout, c. 3.3 km from Ajana–Kalbarri road, in Kalbarri National Park, 27°48'S, 114°29'E, 21 Aug. 1985, A. Brown & S. van Leeuwen 216 (PERTH 00843784); “Painted Cliffs”, 50 km E of Lake Cronin crossroads, 32°16'S, 120°15'E, 5 Aug. 1980, A.S. George 15825 (PERTH 00294705); N slope of Mt Heyward, 33°20'S, 122°32'E, 8 Aug. 1980, A.S. George 15872 (PERTH 00260916); Wardagga Hill, N side of NE running gully, SW of Paynes Find, 29°22'S, 117°30'E, 12 Aug. 1981, S.D. Hopper 1850 (PERTH 00250627); 4.5 km NE from Watheroo, 2.5 km along Carot Well Rd, 30°16'S, 116°05'E, 31 July 1985, S.D. Hopper 4434a (PERTH 00843806); Split Rocks, 31°57'S, 119°39'E, 2 Sep. 1986, S.D. Hopper 5413 (PERTH 00843814); Mt Buraminya, 33°14'S, 123°08'E, 23 Aug. 89, S.D. Hopper 7444 (PERTH 1829815); Mt Ney, 40 km N of Condingup, 33°24'S, 122°28'E, 12 Sep. 91, S.D. Hopper 8184 (PERTH 1829157).

Distribution and habitat. Occurs from Nerren Nerren Station to Mt Ragged in the northern, central and eastern wheatbelt and adjacent goldfields regions. Often grows on granite outcrops beneath scrub, but may be found in mallee and heath on sandplain in well-watered situations. Soils vary from sands to loamy clays. (Figure 62C)

Flowering period. July to late September.

Etymology. Named from the Greek *pachy* (thick) and *-chilus* (-lipped), alluding to the thickened callus on the apex of the labellum lamina compared with that of *Caladenia cairnsiana*.

Notes. *Caladenia pachychila* is a locally common species of patchy distribution, previously considered to be a variant of *C. cairnsiana*. *C. pachychila* differs in its generally shorter scapes, paler floral colouration, petals and sepals splayed down somewhat obliquely away from the ovary with a slightly incurved apex, its labellum lamina with thin pale maroon radiating stripes, held obliquely upwards below 45°, triangular with rounded entire margins in outline when flattened, slightly ascending with downcurved margins over entire length, terminating in a noticeably thickened red-maroon V-shaped apical callus 2–3 mm long, margins at widest point moderately curved downwards and terminated by vertically descending margins, and its generally more inland distribution

Both *Caladenia pachychila* and *C. cairnsiana* are pollinated by sexually-deceived male thynnid wasps, and experiments using bait flowers have confirmed that different species of pollinators are involved (A.P. Brown, unpublished). This biological barrier lends further credence to the recognition of *C. pachychila* as a distinct species.

Caladenia pachychila hybridizes with *C. incensa* in the north-eastern wheatbelt and adjacent

pastoral country. Heberle (1982) records hybrids of *C. pachychila* [as *C. cairnsiana*] and *C. douthiae* at Lake Grace.

***Caladenia paradoxa* Hopper & A.P. Br. sp. nov.**

Caladenia tentaculata Tate, *Trans. & Proc. Roy. Soc. South Australia* 12: 130 (1889), *nom. illeg., non* Schldl. (1847). – *Caladenia filamentosa* var. *tentaculata* R.S. Rogers in Black, *Fl. S. Austral.* 1st edn 1: 138 (1922). *Type*: Caroon Hill, 45 miles [72 km] W of Port Augusta, South Australia, August 1889, W.L. Cleland (*holo*: AD).

A *Caladenia pendens* Hopper & A.P. Br. floribus plerumque brevioribus sepalis lateralibus 5–10 cm longis, 2–3 mm latis, et labello sagittato plus anguste brevior 8–12 mm longo, 5.5–7 mm lato differt.

Typus: Duladgin Rock Nature Reserve, 35 km east-north-east of Southern Cross, 31°10'S, 119°41'E, Western Australia, 4 September 1984, S.D. Hopper 4042 (*holo*: PERTH 003358941; *iso*: AD, CBG, K, MEL).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 48 [as *Caladenia flaccida* subsp. *flaccida*] – the specimens in this photo were close to concluding anthesis and their upswept petals are not typical of the taxon in full anthesis (1992) and rev. 2nd edn with suppl., p. 48 [as *C. flaccida*] (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 5–10 cm x 2–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 12–30 cm tall. *Flowers* 1–3, c. 6–10 cm across, cream with maroon lines, spots and blotches; floral odour sometimes faint, sweet. *Sepals and petals* stiffly held near base with lax apices, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5–10 cm x 1.5–2 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 5–10 cm x 2–3 mm. *Petals* spreading horizontally, then downcurved to vertical, 5–9.5 cm x 2–2.5 mm. *Labellum* cream with pale fawn linear basal radiating blotches and markings, stiffly articulate on a claw c. 1 mm wide; lamina linear-rhomboidal to narrowly triangular in outline when flattened, 8–12 x 5.5–7 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate with broadly truncate to triangular forwardly uncinat cream calli with a cream tip, decrescent towards the apex. *Lamina calli* in 7–12 pairs in 2 rows extending about half the length of the labellum, cream, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 9–10 x 3–4 mm, narrowly winged, pinkish red or cream with fawn markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5–2 x 1.5–2 mm, greenish-yellow. *Pollinia* c. 1.0–1.5 mm long, yellow. *Stigma* c. 1.5–2 mm wide. *Capsule* not seen.

Selected specimens examined. WESTERN AUSTRALIA: 3 km SE of Karlgarin Hill, on the Kondinin–Hyden road, 32°30'S, 118°34'E, 16 Aug. 1978, S.D. Hopper 1053 (PERTH 00272213); Piawaning turnoff on the Wongan Hills–Ballidu road, 30°53'S, 116°42'E, 12 Aug. 1983, S.D. Hopper 3125 (PERTH 00270245); SE slopes of Hines Hill, 24 km WSW of Merredin, 31°32'S, 118°03'E, 15 Aug. 1984, S.D. Hopper 3986 (AD, CBG, K, PERTH 00271713); Muddarning Hill, 3 km SE of Mt Jackson, 30°15'S, 119°18'E, 1 Sep. 1984, S.D. Hopper 4013 (PERTH 00254673); 6.8 km S of Mt Hampton, 31°49'S, 119°05'E, 5 Sep. 1984, S.D. Hopper 4063a,c (PERTH 01935100); top of Middle Ironcap, c.

80 km ESE of Hyden, 32°35'S, 119°45'E, 1 Sep. 1986, *S.D. Hopper* 5380 (PERTH 01191942); Great Northern Highway, 1 km NNE of Wubin, 30°06'S, 166°39'E, 23 Aug. 1988, *S.D. Hopper* 6504a,b (PERTH 01932497); Nargalyerin Rock Nature Reserve, near the N boundary, c. 90 km E of Merredin, 31°27'S, 119°10'30" E, 17 Sep. 1988, *S.D. Hopper* 6703 (PERTH 01196731).

Distribution and habitat. Locally common in Western Australia on seasonally damp soils near granite outcrops or lateritic hills in the wheatbelt from Wubin and Hines Hill to the Southern Cross–Merredin district, and extends southwards to near Lake King. For possible eastern States populations, see discussion below. (Figure 62D)

Flowering period. August to September.

Etymology. Named from the Latin *paradoxus* (marvellous, strange, contrary to expectations), alluding to the difficulty we had in finally resolving the specific status of *Caladenia paradoxa*. Initially (in the early 1980s), we thought it was a form of *C. denticulata*, then of *C. dimidia*, and for some time considered it conspecific with the eastern Australian *C. flaccida* (Jones 1991), and allied to *C. pulchra* (Hoffman and Brown 1992, 1998). It was not until the final amendments to this manuscript were being made that we resolved the paradox.

Notes. *Caladenia paradoxa* is a necessary new name for *C. filamentosa* var. *tentaculata*, since the latter epithet had been used in 1847 by Schlechtendahl at the specific level for an orchid in the *C. dilatata* complex from South Australia and Victoria. The type of *C. filamentosa* var. *tentaculata* is a good match for *C. paradoxa* (lateral sepals, for example, are 7–8 cm long), so we consider it to be conspecific.

The taxonomy of this species has been problematic, and remains so for anomalous populations in South Australia, western Victoria and south-western New South Wales. In Western Australia, there are a number of cream-flowered species in the *Caladenia filamentosa* complex. *C. vulgata*, *C. pendens*, *C. nobilis* and *C. exilis* share with *C. paradoxa* pendulous lateral sepals and petals. However, *C. paradoxa* differs from these four species in having a smaller labellum. From *C. exilis* in particular, *C. paradoxa* also differs in its linear-rhomboidal to narrowly triangular labellum, and its habitat of seasonally damp sites near granite outcrops or lateritic hills, not the salt lake margins favoured by *C. exilis*. *C. paradoxa*'s long slender drooping sepals and petals are distinctive features that distinguish the species from other cream-flowered species with a similar-sized labellum such as *C. hiemalis* and *C. dimidia*. *C. microchila* differs from *C. paradoxa* by its smaller labellum and stiffly held tepals.

In resolving the identity of specimens from South Australia, western Victoria and south-western New South Wales, care would need to be taken in discriminating between *Caladenia paradoxa* and other cream-flowered members of the *C. filamentosa* complex, including *C. flaccida* and *C. microchila*.

Although we once considered *Caladenia paradoxa* to be conspecific with *C. flaccida* (e.g. Hoffman & Brown 1992, 1998), we have been able to re-examine specimens and drawings (courtesy of D.L. Jones) of the type population of *C. flaccida* from Sim's Gap in New South Wales (Jones 1991). It is clear that *C. paradoxa* differs from typical *C. flaccida* in its shorter leaves less than half the length of the scape, its somewhat longer petals and sepals, and its slightly longer labellum.

Caladenia paradoxa hybridizes with *C. dimidia* at locations near Merredin, Hines Hill and Wubin. *C. pulchra* also grows and intergrades with *C. paradoxa* near Ongerup.

Caladenia pendens* Hopper & A.P. Br., *sp. nov.

A *Caladenia nobilis* Hopper & A.P. Br. floribus plerumque brevioribus sepalis lateralibus 6–12 cm longis, 3–5 mm latis, et labello sagittato plus anguste brevior 11–19 mm longo, 9–12 mm lato differt.

Typus: Camel Peaks, 16 km north-north-east of Hyden, 32°18'S, 118°51'E, Western Australia, 14 September 1985, S.D. Hopper 4577 (*holo*: PERTH 00907502; *iso*: AD, CBG).

Plant solitary or in small clumps. *Leaf* erect, linear, 8–13 cm x c. 3–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–30 cm tall. *Flowers* 1–3, c. 7–10 cm across, cream to dark pinkish maroon, with pale to dark maroon lines, spots and blotches; floral odour sometimes faint, sickly sweet or strongly citrus. *Sepals and petals* stiffly held near base with lax pendulous apex, linear-lanceolate in basal 1/7–1/5, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 6–12 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 6–12 cm x 3–5 mm. *Petals* spreading horizontally, then downcurved to vertical, 5.5–12 cm x 3–4 mm. *Labellum* cream with dark maroon radiating basal lines, blotches and markings, stiffly articulate on a claw c. 1.5–2 mm wide; lamina narrowly rhomboidal to triangular in outline when flattened, 11–19 x 9–12 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins serrate, with triangular forwardly uncinat cream to dull maroon marginal calli, with tip cream, decrescent towards the apex. *Lamina calli* in 12–20 pairs in 2 rows extending up to half the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 10–15 x 4–7 mm, narrowly winged, pinkish red or cream with fawn to maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 3–4 x 3–4 mm, greenish-yellow. *Pollinia* c. 3 mm long, yellow. *Stigma* c. 3–4 mm wide. *Capsule* not seen.

Distribution and habitat. Extends sporadically throughout the central and western wheatbelt and adjacent forest from the Watheroo–Wongan Hills area south to near Wagin and Hyden, with a possible outlier on Cape Naturaliste. Grows in sandy soils or sandy clay-loams associated with granite outcrops, salt lakes, swamps and rivers.

Flowering period. September to October.

Etymology. Named from the Latin *pendens* (pendulous), alluding to the consistently lax pendulous apices of the sepals and petals.

Notes. *Caladenia pendens* is an uncommon species sporadically distributed in relict well-watered situations. Apart from *C. nobilis* it has the longest sepals and largest labellum in the *C. vulgata* group, with big specimens approaching *C. nobilis* in size. However, *C. pendens* differs from *C. nobilis* in its narrower labellum, its flowers usually smaller and with a sickly sweet or citrus-like odour, its petals and sepals consistently with a lax pendulous apex, its marginal labellum calli consistently serrate, its central calli extending only to half the length of the labellum lamina, and its more inland distribution. *C. pendens* grows near to and may also be confused with *C. vulgata*, but differs in its generally larger flowers, with longer tepals and column, its petals and sepals consistently with a lax pendulous apex, and its marginal labellum calli are consistently serrate.

A population possibly of *Caladenia pendens* has been found near Dunsborough on the Leeuwin–Naturaliste Ridge, but it differs from wheatbelt populations in its pale yellowish colouration.

There are two subspecies of *Caladenia pendens*, distinguished in the following key:

Key to subspecies of *Caladenia pendens*

1. Flowers cream, with pale to dark maroon lines, spots and blotches; floral odour sometimes faint, sickly sweet. Petals 8–12 mm long.
Labellum lamina 15–19 mm long subsp. **pendens**
- 1: Flowers dark pinkish maroon (rarely cream), with pale to dark maroon lines, spots and blotches; floral odour strongly citrus. Petals 5.5–9 mm long.
Labellum lamina 11–17 mm long subsp. **talbotii**

Caladenia pendens* Hopper & A.P. Br. subsp. *pendens

Caladenia varians subsp. *pendens* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 34 (1992).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), Orchids of Western Australia—cultivation and natural history, colour plate d opposite p. 41 [as *Caladenia denticulata*] (1989); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 34 [as *Caladenia varians* subsp. *pendens*] (1992) and rev. 2nd edn with suppl., p. 34 (1998).

Flowers cream, with pale to dark maroon lines, spots and blotches; floral odour sometimes faint, sickly sweet. *Petals* 8–12 mm long. *Labellum lamina* 15–19 mm long. (Figure 57S–V)

Selected specimens examined. WESTERN AUSTRALIA: Graham Rock, 17.5 km E of Hyden, 32°28'S, 119°03'E, 6 Sep. 1984, *S.D. Hopper* 4078a (PERTH 00271748); 800 m W of Wedin N road on Wickepin–Harrismith road, 32°55'S, 117°42'E, 7 Sep. 1984, *S.D. Hopper* 4118a (CBG, PERTH 01858548); 400 m N of Bullaring–Pingelly road on Bulyee Rd, 32°31'S, 117°31'E, 7 Sep. 1984, *S.D. Hopper* 4131 (CBG, PERTH 00691712); 13 km S of Wagin on Norring Lake Rd, 33°25'S, 117°53'E, 23 Sep. 1984, *S.D. Hopper* 4160 (CBG, PERTH 00264954); Cape Naturaliste Rd, 500 m SE of Eagle Bay turnoff, 33°35'S, 115°04'E, 26 Sep. 1985, *S.D. Hopper* 4658 (CBG, PERTH 00910708); Birdwhistle Rock, c. 27 km ENE of Narrogin, 32°53'S, 117°28'E, 23 Sep. 1988, *S.D. Hopper* 6770 (PERTH 01191977).

Distribution and habitat. Extends sporadically throughout the central wheatbelt from the Wongan Hills area south to near Wagin and Hyden. Grows in well-watered sandy soils associated with isolated granite outcrops or with rises near salt lakes and rivers. A population possibly of *Caladenia pendens* subsp. *pendens* has been found near Dunsborough on the Leeuwin–Naturaliste Ridge. (Figure 63A)

Flowering period. September to October.

Notes. This is the most widespread of the two subspecies, typified by its consistently coloured cream flowers, usually longer petals and labellum, and its sickly sweet floral odour.

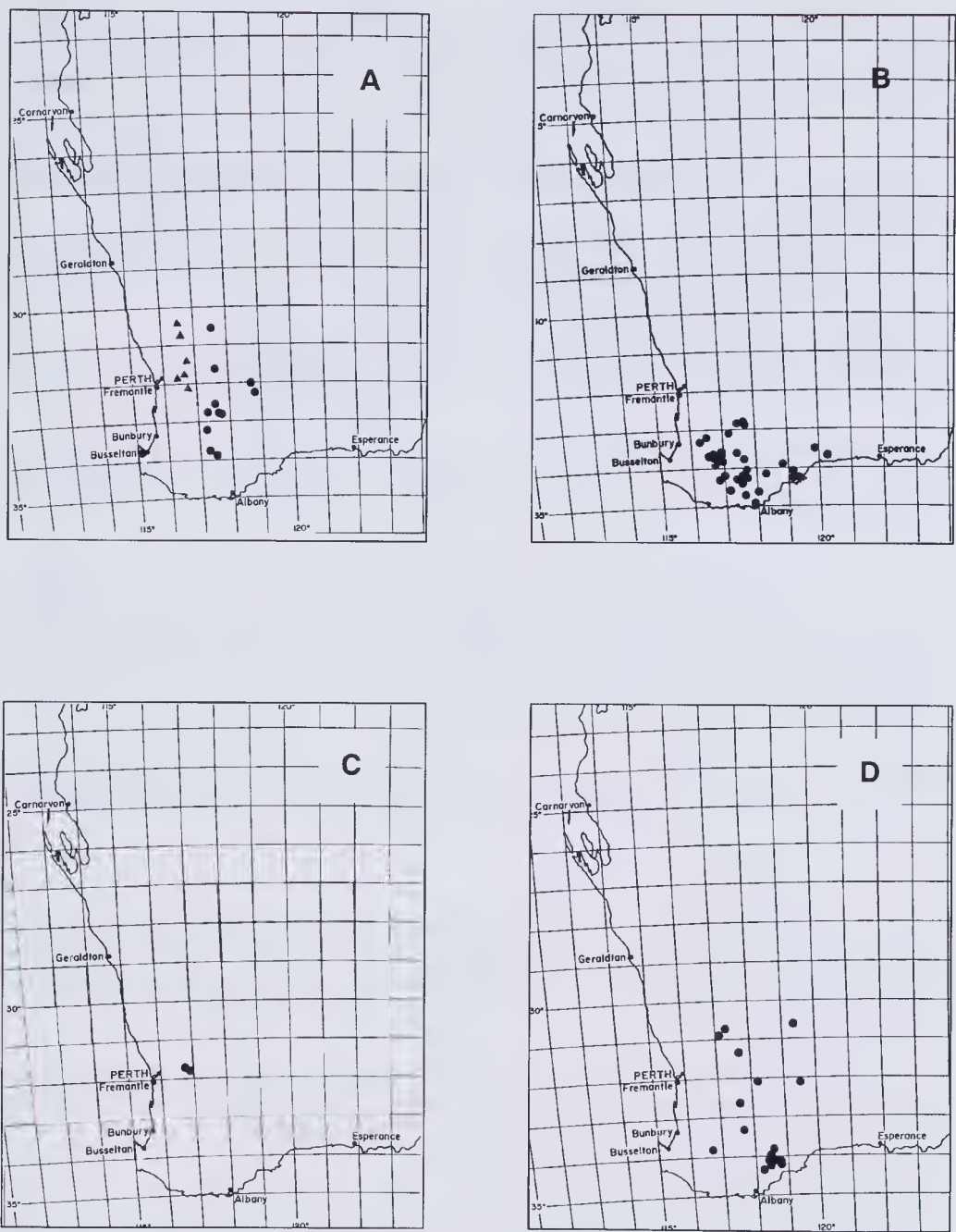


Figure 63. Distribution maps. A – *Caladenia pendens* subsp. *pendens* ● and *C. pendens* subsp. *talbotii* ▲ ; B – *C. polychroma*; C – *C. postea*; D – *C. pulchra*.

***Caladenia pendens* subsp. *talbotii* Hopper & A.P. Br., subsp. nov.**

Caladenia varians subsp. *talbotii* Hopper & A.P. Br. *nom. inval. in* Hoffman & Brown, Orchids of South-West Australia, 2nd edn: p. 40 (1992).

A subspeciebus aliis petalis sepalisque crassis atro roseis vel cremeis lineis suffusionibus marroneis prominentibus differt.

Typus: 1 km west of Dobaderry Road, 32 km south-west of Beverly, 32°12'S, 116°36'E, Western Australia, 11 September 1987, *S.D. Hopper* 6019 (*holo*: PERTH 01201484).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 40 [as *Caladenia varians* subsp. *talbotii* *nom. inval.*] (1992) and rev. 2nd edn with suppl., p. 40 (1998).

Flowers dark pinkish maroon (rarely cream), with pale to dark maroon lines, spots and blotches; floral odour strongly citrus. *Petals* 5.5–9 mm long. *Labellum lamina* 11–17 mm long. (Figure 64A–K)

Selected specimens examined. WESTERN AUSTRALIA: c. 1 km W of Dobaderry Rd, 4 km N of Dale West Rd, c. 32 km SW of Beverly, 32°12'S, 116°36'E, 11 Sep. 1987, *S.D. Hopper* 6019 (PERTH 01201484); 5 miles [8 km] N of York, 20 Sep. 1925, *Miss Price s.n.* (PERTH 00265969); Dryandra State Forest, Narrogin map 1:100,000, Grid Reference 003730, 16 Sep. 1987, *D.M. Rose* 245 (PERTH 01700472); Pennyroyal Gully, 0.25 mile [600 m] above spring, 22 Oct. 1905, *O.H. Sargent s.n.* (PERTH 00266396).

Distribution and habitat. A poorly known subspecies apparently confined to winter-wet Wandoo flats in the eastern Jarrah forest to the south-west of York, northwards to the Watheroo area. (Figure 63A)

Flowering period. September to October.

Etymology. Named after Mr Len Talbot (1926–), forester with the Forests Department and (since 1985) the Department of Conservation and Land Management, until his retirement in 1991, in appreciation of the considerable assistance he has provided us in searching for and locating rare forest plants. Len accompanied SDH on several trips to locations of the orchid named after him.

Notes. *Caladenia pendens* subsp. *talbotii* is apparently restricted to a small area of the eastern Jarrah forest. Its conservation status requires further research. It is more colourful than the nominate subspecies, and has shorter petals and labellum, with a citrus floral odour.

***Caladenia polychroma* Hopper & A.P. Br., sp. nov.**

A *Caladenia dimidia* Hopper & A.P. Br. floribus majoribus differt; a *C. vulgata* Hopper & A.P. Br. petalis sepalisque rigide effusis et callis brevibus.

Typus: 5.5 km west-north-west of Lake Nuniup, 26 km west-north-west of Kendenup on road to Frankland, 34°23'S, 117°22'E, Western Australia, 1 October 1983, *S. D. Hopper* 3412 (*holo*: PERTH 00268321; *iso*: AD, CANB, MEL).

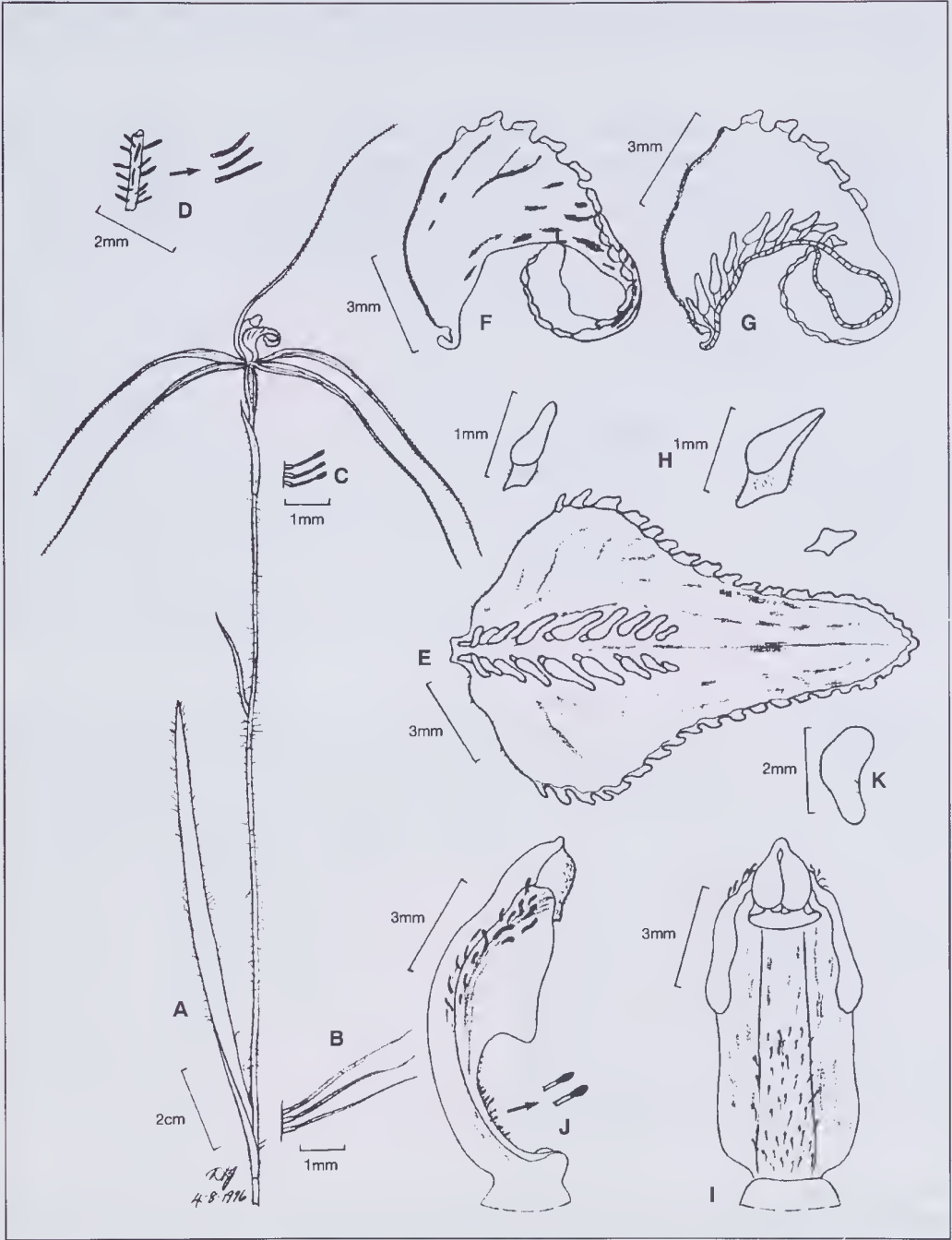


Figure 64. *Caladenia pendens* subsp. *talbotii* from Eagle Hill Rd, north of Watheroo, C.J. French s.n. A – plant; B – hairs from lower scape; C – glandular hairs on upper scape; D – hairs from tepal apex; E – flattened labellum from above; F – labellum from side; G – longitudinally sectioned labellum from side; H – labellum lamina calli; I – column from front; J – column from side; K – pollinia. Drawn by D.L. Jones.

Illustrations. D. Jones, Native Orchids of Australia, p. 113 top photo [as *Caladenia denticulata*] (1988); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 43 (1992) and rev. 2nd edn with suppl., p. 43 (1998).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 7–12 cm x 3–4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–30 cm tall. *Flowers* 1 or 2(3), c. 8–12 cm across, variable in colour from white to yellow or dark maroon, with maroon suffusions, lines or blotches; floral odour strong, like burning metal. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–10 cm x 2–3 mm. *Lateral sepals* spreading obliquely downwards, 4.5–10 cm x 3–4 mm. *Petals* spreading obliquely upwards to horizontal or obliquely downwards, 4.5–9 cm x 2–3 mm. *Labellum* pale yellow-cream with prominent radiating maroon stripes and markings, becoming large irregular spots and blotches (rarely uniformly maroon) towards the recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina rhomboidal in outline when flattened, 10–17 x 10–13 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by ascending calli, distal margins dentate with truncate white to pale maroon marginal calli decrescent towards the apex. *Lamina calli* in 6–14 pairs in 2 rows extending about half the length of the labellum, creamy-white, narrowly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 10–13 x 4–6 mm, narrowly winged, creamy yellow with maroon blotches, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2.5 x 2.5 mm, pale yellow or greenish-yellow. *Pollinia* c. 1–1.5 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 65A–F)

Selected specimens examined. WESTERN AUSTRALIA: 20 km SE of Moodiarrup on the Collie–Changerup road, 33°43'S, 116°56'E, 28 Sep. 1985, A. Brown 231 (AD, CBG, K, MELB, PERTH 00905895); Gordon River Bridge, NW of Cranbrook on Albany Highway, 34°14'S, 117°27'E, 1 Oct. 1983, A. Brown s.n. (PERTH 00335436 CBG); Water Reserve Number 21748, S of Borden township, 34°05'S, 118°15'E, 11 Sep. 1982, A. Brown & S.D. Hopper 2564 (CBG, PERTH 00267341); 26 km ENE of Wilga, 33°39'S, 116°30'E, 2 Oct. 1984, E. Chapman s.n. (AD, CANB, K, MEL, PERTH 01670131); 7 km E of Toolibin Lake, 32°55'S, 117°42'E, 7 Sep. 1980, A.S. George 16198 (PERTH 00268798); 7.5 km NE of Mount Barker on North Carbarup Rd, 34°34'S, 117°42'E, 30 Sep. 1983, S.D. Hopper 3404 (PERTH 00268364); 6.8 km S of Mt Hampton, 31°49'S, 119°05'E, 5 Sep. 1984, S.D. Hopper 4063 (PERTH 00272639); Graham Rock, 17.5 km E of Hyden, 32°28'S, 119°03'E, 6 Sep. 1984, S.D. Hopper 4078a (PERTH 01935097); Pallarup Rock, 44.5 km NNW of Ravensthorpe, 33°15'S, 119°45'E, 6 Sep. 1984, S.D. Hopper 4094b (PERTH 01935186); Stirling Range National Park, between Bluff Knoll Road and Papa Cola Creek on Chester Pass Rd, 34°20'S, 118°12'E, 21 Sep. 1984, S.D. Hopper 4158 (PERTH 00792357); Bremer River crossing on Devils Rd, 29 km NW of Bremer Bay, 34°13'S, 119°09'E, 5 Oct. 1984, S.D. Hopper 4218 (AD, CBG, K, PERTH 00266914); Tenterden Nature Reserve, 34°22'S, 117°33'E, 15 Oct. 1986, S.D. Hopper 5716 (PERTH 01191969).

Distribution and habitat. Extends from Ravensthorpe west to Tone Bridge, and north to Katanning. Mainly favours damp soils associated with Wandoo or Swamp Yate open woodlands. (Figure 63B)

Flowering period. September to October.

Etymology. Named from the Greek *poly-* (many, numerous), and *chromus* (pertaining to colour), alluding to the variable floral colouration.

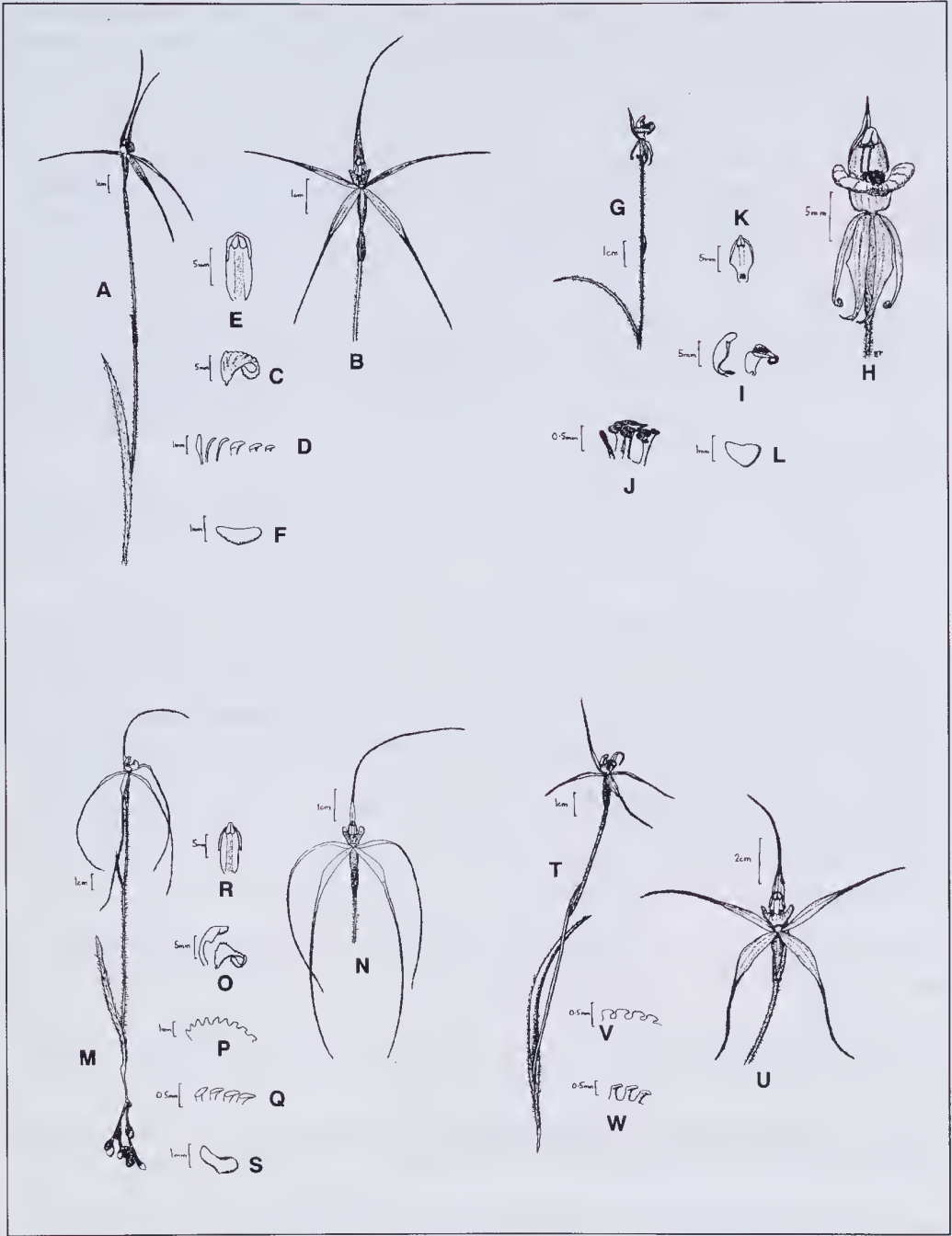


Figure 65 A–F. *Caladenia polychroma* from Stirling Range, S.D. Hopper 4158. A – plant; B – flower from front; C – labellum from side; D – labellum lamina calli; E – column from front; F – pollinia. G–L. *C. voigtii* from the Salmon Gums area, A.P. Brown 744. G – plant; H – flower from front; I – labellum and column from side; J – labellum lamina calli; K – column from front; L – pollinia. M–S. *C. vulgata* from Yalgorup National Park, S.D. Hopper 6051. M – plant; N – flower from front; O – labellum and column from front; P – labellum fringe; Q – labellum lamina calli; R – column from front; S – pollinia. T–W. *C. xantha* from the Katanning area, A.P. Brown s.n. T – plant; U – flower from front; V – labellum fringe; W – labellum lamina calli. Drawing by S.J. Patrick.

Notes. *Caladenia polychroma* is a common and widespread species of the south-western and southern wheatbelt and adjacent areas. It differs from *C. dimidia* in its larger flowers, the filiform apices are 3/4–4/5 the total length of its petals and sepals, its more southerly and south-westerly distribution, and its preference for wetter soil conditions in Wandoo and Swamp Yate woodlands.

Caladenia polychroma differs from the rare *C. fuscolutescens* in its larger flowers varying from white to yellow or dark maroon, with maroon suffusions, lines or blotches, its stiffly held petals and sepals linear-lanceolate in basal 1/5–1/4, its petals spreading obliquely upwards to horizontal or obliquely downwards, and its preference for damp soils further to the north and east.

Along with several other new taxa described herein, *Caladenia polychroma* for a long time has been regarded as a variant of *C. filamentosa* var. *denticulata*, or as *C. denticulata* (e.g. George 1971; Jones 1988). *C. denticulata* is similar to *C. polychroma*, but differs in its narrower paler-coloured labellum with narrow well-spaced labellum marginal calli, and the arching petals and lateral sepals with a pendulous apex. *C. polychroma* has flowers similar in size to those of *C. pendens*, but differs in its stiffly splayed petals and sepals, and in its squat calli that are white on top.

Uncommon yellow variants of *Caladenia polychroma* occur near the rare *C. luteola*, but differ in their longer filamentous apices to the petals and sepals, their shorter column, and the non-glistening tops to the central calli of the labellum lamina.

Caladenia polychroma is one of the most locally abundant taxa in the Western Australia *C. filamentosa* complex. Northern and eastern populations are somewhat smaller-flowered than south-western populations centred in the Borden area. *C. polychroma*'s variable colouration within populations is a source of delight, often added to by the occurrence of uncommon hybrids with species such as *C. roei*, *C. cairnsiana* and *C. douthiae*. *C. polychroma* also appears to hybridize with *C. dimidia* near Jerramungup, Borden and further north near Narrogin, Wedin and Pingelly, and with *C. pulchra* near Jerramungup. It may do likewise with *C. xantha* and *C. chapmanii* at sporadic sites along the western margins of the wheatbelt.

***Caladenia postea* Hopper & A.P. Br., sp. nov.**

Caladenia varians subsp. *postea* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 30 (1992).

A *Caladenia vulgata* Hopper & A.P. Br. petalis sepalisque rigide ferentibus basaliter, tum deorsum arcuatis, et florescentia serotina differt.

Typus: Junction of Darkan and Warrigal Rds, Flynn State Forest, 32°05'S, 116°27'E, Western Australia, 26 October 1999, *F. Hort* 749 (*holo:* PERTH 05444292).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 30 [as *Caladenia varians* subsp. *postea*] (1992) and rev. 2nd edn with suppl., p. 30 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 7–10 cm x c. 3–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 16–20 cm tall. *Flowers* 1 or 2, c. 4–5 cm across, cream, with pale maroon lines, spots and blotches; floral odour faint, like burning metal. *Sepals and petals* stiffly held near base with lax apex, linear-lanceolate in basal 1/3–1/2, then abruptly narrowing

to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4–5.5 cm x c. 2 mm. *Lateral sepals* arching, spreading obliquely downwards, becoming vertical, 4–5.5 cm x 2–3 mm. *Petals* arching, spreading horizontally, then downcurved to vertical, 3.5–4.5 cm x c. 2–3 mm. *Labellum* cream with pale maroon radiating basal lines, blotches and markings, stiffly articulate on a claw c. 1 mm wide; lamina, linear-rhomboidal in outline when flattened, 8–14 x 7–9 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal 2/5, nearly horizontal in middle 2/5, apical 1/5 sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate-serrate with narrowly anvil-shaped to triangular forwardly uncinuate cream to dull maroon marginal calli with cream apex, decrescent towards the apex. *Lamina calli* in 8–14 pairs in 2 rows extending up to half the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 9–11 x 3–6 mm, narrowly winged, pinkish red or cream with fawn to pale maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 66)

Distribution and habitat. A rare species recorded between the Brookton Highway and York. Grows in Wandoo open woodland along a flat-floored drainage line. (Figure 63C)

Flowering period. Late October to November.

Etymology. Named from the Latin *postea* (afterwards, later), alluding to the late flowering season of the species.

Notes. Represented in herbaria only by the type collection. *Caladenia postea* has been searched for extensively and is a rare species. Known from just two populations west of York (Priority One).

The only other late-flowering members of the Western Australia. *Caladenia filamentosa* complex are *C. evanescens*, *C. abbreviata* and *C. ultima*, all found much nearer the south coast. *C. postea* differs from these taxa in its arching lateral sepals and petals, and its labellum which is erect with entire margins in the basal 2/5, nearly horizontal in the middle 2/5, with the apical 1/5 sharply recurved.

Caladenia postea is related to *C. denticulata*, differing in its generally shorter scapes and smaller flowers with a shorter labellum, shorter column, consistently cream colouration, and its later flowering period.

Caladenia pulchra Hopper & A.P. Br., *sp. nov.*

Caladenia flaccida subsp. *pulchra* Hopper & A.P. Br. *nom. inval.* in Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 47 (1992).

A *Caladenia paradoxa* Hopper & A.P. Br. scapis altioribus petalis sepalisque longioribus et colore variabili florum differt.

Typus: 5 km south of Jerramungup, 5 km north of Carlawillup Rd, 33°58'S, 118°56'E, Western Australia, 5 October 1984, S.D. Hopper 4208 (*holo:* PERTH 00241539; *iso:* AD, CANB, K, MEL, NSW, PERTH).

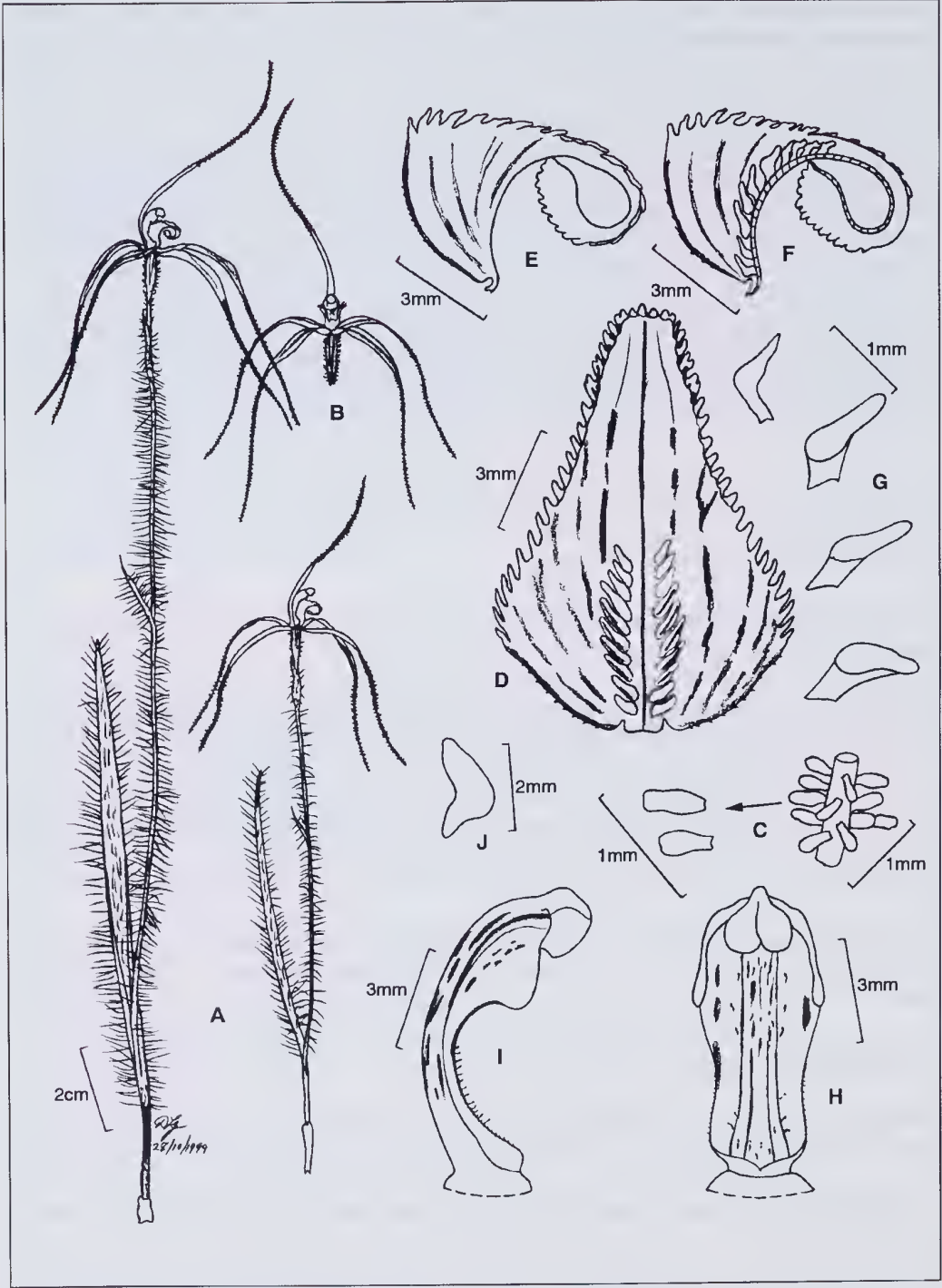


Figure 66. *Caladenia postea* from Darkin River crossing, Yarra Road, C.J. French s.n. A – plants; B – flower from front; C – hairs from tepal apex; D – flattened labellum from above; E – labellum from side; F – longitudinally sectioned labellum from side; G – labellum lamina calli; H – column from front; I – column from side; J – pollinia. Drawn by D.L. Jones.

Illustrations. R.J. Bates & J.Z. Weber, Orchids of South Australia. Plate 42 [as *Caladenia filamentosa* var. *filamentosa*] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 47 [as *C. flaccida* subsp. *pulchra*] (1992) and rev. 2nd edn with suppl., p. 47 (1998).

Plant solitary or in small clumps. *Leaf* erect, linear, 6–15 cm x 3–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 20–40 cm tall. *Flowers* 1–3, c. 4–10 cm across, pinkish, red or yellow with maroon lines, spots and blotches; floral odour sometimes faint, like burning metal. *Sepals and petals* stiffly held near base with lax apices, linear-lanceolate in basal 1/8–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 6–10 cm x 1.5–2.5 mm. *Lateral sepals* 6–10 cm x 2–3 mm, spreading obliquely downwards, becoming vertical. *Petals* 6–11 cm, x 2–2.5 mm, spreading horizontally, then sowncurved to vertical. *Labellum* cream with prominent dark radiating basal lines and apical markings, stiffly articulate on a claw c. 1 mm wide; lamina narrowly rhomboidal to narrowly triangular in outline when flattened, 8–11 x 5–8 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate with broadly to narrowly truncate to triangular forwardly uncinate cream to red marginal calli with cream tip, decrescent towards the apex. *Lamina calli* in 7–12 pairs in 2 rows extending about half the length of the labellum, cream with red-pink markings to cream, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 7–10 x 2.5–3 mm, narrowly winged, pinkish red, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 67)

Selected specimens examined. WESTERN AUSTRALIA: Durokoppin Nature Reserve, c. 13 km SSW of Letchford Road on Kellerberrin–Bencubbin road, 31°18'S, 117°48'E, 17 Aug. 1988, A. Brown 830 (CBG, PERTH 01201409); 24 km NNE of Dinninup, 1 km E of SW corner of Reserve, 33°36'S, 116°36'E, Aug. Sep. 1984, E. Chapman s.n. (PERTH 00404357); Mundaring Hill, 30°15'S, 119°18'E, 1 Sep. 1984, S.D. Hopper 4016 (PERTH 00251224); Graham Rock, 17.5 km E of Hyden, 32°28'S, 119°03'E, 6 Sep. 1984, S.D. Hopper 4078b,c (PERTH 01935089); Malyalling Rock, 12 km NE of Wickepin, 32°43'S, 117°37'E, 7 Sep. 1984, S.D. Hopper 4126 (PERTH 00271675); Gairdner River Nature Reserve, c. 17 km NW of Jerramungup, 33°49'S, 118°48'E, 24 Sep. 1988, S.D. Hopper 6793 (AD, CBG, PERTH 01201387); Split Rocks, c. 95 km SSE of Southern Cross, 13 Sep. 1981, K.R. Newbey 8791 (PERTH 00251623).

SOUTH AUSTRALIA: Telowie Gorge Conservation Park, 33°00'S, 138°10'E, 3 Sep. 1985, R. Bates 6041 (AD, BRI, CANB, HO, MEL, NSW, PERTH); Mt Remarkable National Park, 32°48'S, 138°10'E, 12 Sep. 1986, R. Bates 6995 (AD); Flinders Ranges, Hartley, 20 Aug. 88, R. Bates 15055 (AD, PERTH); 240 km N of Adelaide, 16 Sep. 61, E.N.S. Jackson 361 (AD).

Distribution and habitat. In Western Australia, known from the Jerramungup district (where it is most abundant) to the Wongan Hills and near Mt Jackson. In South Australia, known only from the southern Flinders Range. In Western Australia, occurs in seasonally damp sites near granite outcrops and along creeklines, often in sheoak (*Allocasuarina*) thickets. In South Australia, it is reported as being “rare on rock ledges” and “In rocky places, gravelly soil, on south-west tops of ridges”. (Figure 63D)

Flowering period. September to early October.

Etymology. Named from the Latin *pulchre* (beautifully, excellently), alluding to the delicate long beautifully coloured sepals and petals of the subspecies.

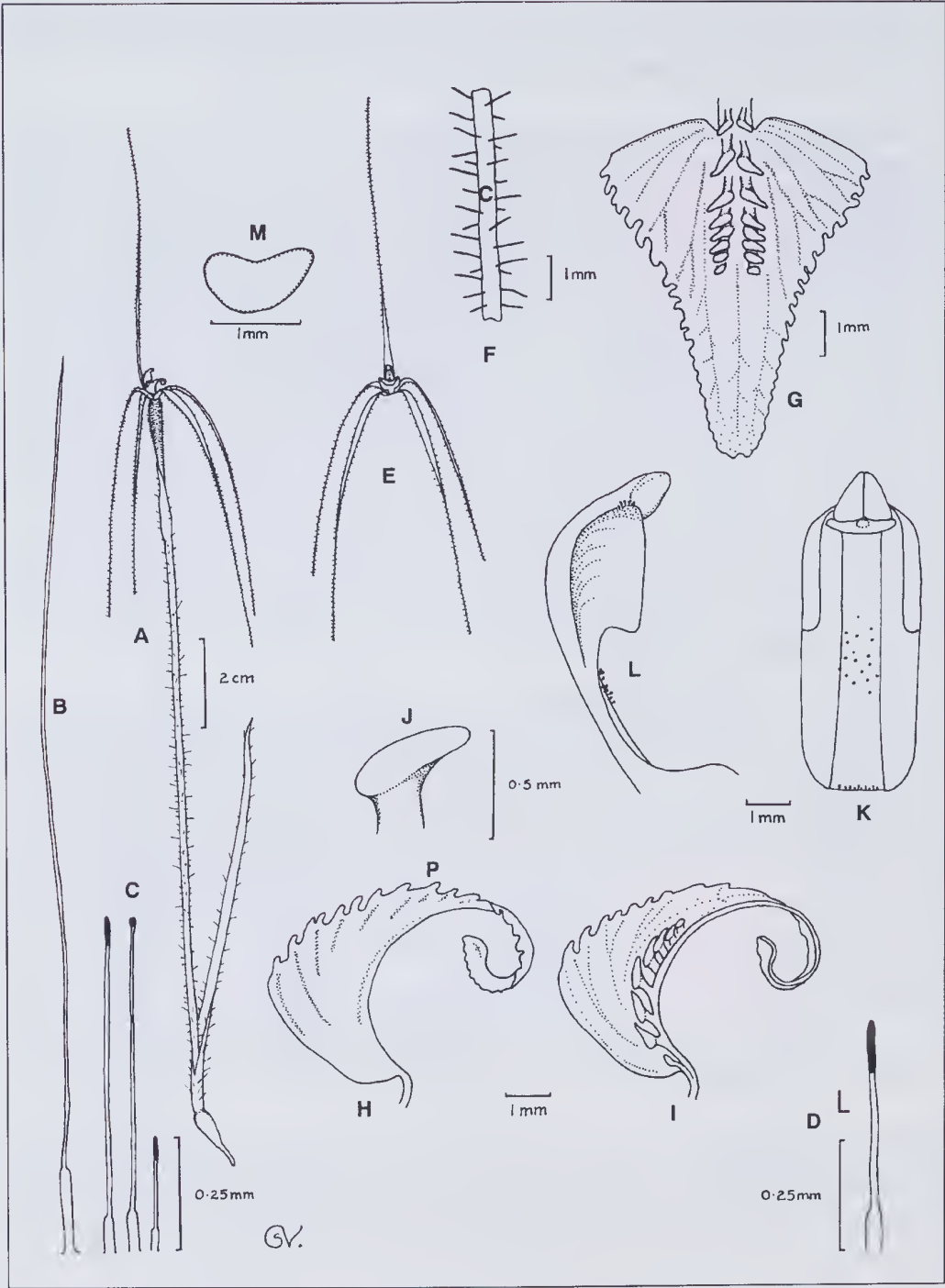


Figure 67. *Caladenia pulchra* from the Jerramungup area, S.D. Hopper 6791. A – plant; B – leaf hair; C – stem hairs; D – ovary hair; E – flower from front; F – hairs on sepal tips; G – flattened labellum from above; H – labellum from side; I – labellum, side section; J – labellum lamina calli; K – column from front; L – column from side; M – pollinia. Drawn by C. Vasilu.

Notes. *Caladenia pulchra* is a rarely seen but widespread taxon known from scattered sites, where it occurs as sporadic individuals. Little is known of its biology, although male thynnid wasps with pollinia attached have been seen resting on flowers near Jerramungup, and R. Bates (1995, AD) annotated a Mt Remarkable collection with "wasps caught pollinating flowers". An occasional hybrid with *C. doulichiae* has been collected. *C. pulchra* also grows and intergrades with *C. paradoxa* near Ongerup.

From *Caladenia filifera*, *C. pulchra* differs in its variable colouration always with yellow-white margins to the basal lamina of the sepals and petals, and its somewhat smaller labellum with shorter more dentate marginal calli. *C. pulchra* is distantly allied to *C. erythrochila* and *C. sanguinea* from Kangaroo Island in South Australia (Jones 1999), from which it differs in its larger flowers that are variable in colour and have longer more pendulous petals and lateral sepals.

***Caladenia remota* Hopper & A.P. Br., sp. nov.**

A *Caladenia vulgata* Hopper et A.P. Brown foliis complanatus, floribus petalis sepalisque comparate brevis crassiore ferentibus, sepalis lateralibus 5.5–9 cm longis 4–5 mm latis, columna 9–15 mm elata, labello 9–18 mm longo, 8–12 mm lato, et distributione interiore differt.

Typus: south side of "Ray's" rock, c. 6 km south-south-west of Doothagnunganna Hill, c. 50 km north of Yalgoo, 27°54'S, 116°37'E, Western Australia, 26 August 1988, S.D. Hopper 6540 (*holo:* PERTH 05528437; *iso:* CBG, PERTH 01706969).

Plant in small to large clumps, rarely solitary. *Leaf* erect, linear, 15–17 cm x 5–7 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–25 cm tall. *Flowers* 1–3, c. 5–8 cm across, cream to creamy-yellow, with dull maroon lines, spots and blotches; floral odour strongly acrid, like burning metal. *Sepals and petals* stiffly held except for the lax apex, linear-lanceolate in basal 1/7–1/5, then abruptly narrowing to a densely glandular dark brown long-acuminate finely filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 5.5–9 cm x 2.5–5 mm. *Lateral sepals* spreading obliquely downwards, becoming vertical, 5.5–9 cm x 4–5 mm. *Petals* spreading horizontally, then downcurved, 5–8 cm x 2.5–3 mm. *Labellum* cream with dull maroon radiating lines, blotches and markings, stiffly articulate on a claw c. 1.5–2 mm wide; lamina linear-rhomboidal to rhomboidal in outline when flattened, 9–18 x 8–12 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point slightly curved upwards then terminated by scarcely descending calli, distal margins dentate-serrate with anvil-shaped to triangular forwardly uncinate cream marginal calli, decrescent towards the apex. *Lamina calli* in 10–15 pairs in 2 rows extending up to half the length of the labellum, cream to cream with dull maroon apical markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 9–15 x 3–6 mm, narrowly winged, cream with dull maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–2.5 x 2–2.5 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2 mm wide. *Capsule* not seen.

Distribution and habitat. In pastoral country from north of Yalgoo and Eurady Station south into the northern wheatbelt to Wubin and Bonny Rock. Often confined to thickets beside seasonally wet sites on or adjacent to granite outcrops, or on seasonally wet flats in red loam associated with Jam, *Thryptomene* spp. and York Gum.

Flowering period. August to early September.

Etymology. Named from the latin *remotus* (scattered, remote), alluding to the distribution much further inland than related species, as far north as any other *caladenias* have been recorded.

Notes. *Caladenia remota* is a distinctive inland relative of *C. vulgata* characterised especially by its broader leaf, and more splayed usually shorter petals and sepals. It may be found growing near to *C. incensa*, from which it differs in its longer narrower leaves, thinner more erect calli that are dull on top, and preference for wetter soils. Along with *C. hirta* and *C. roei*, these two taxa extend the furthest inland of all south-western *Caladenia*. Southern populations of *C. remota* may occur with *C. dimidia*, but differ in their larger consistently cream flowers with lax apices on the petals and lateral sepals, and their broader leaf. These southern populations have a smaller column and labellum than northern populations, so we recognise two subspecies of *C. remota*.

Key to subspecies of *Caladenia remota*

1. Labellum lamina 13–18 x 11–12 mm. Column 12–15 mm tall subsp. **remota**
- 1: Labellum lamina 9–14 x 8–10 mm. Column 9–11 mm. subsp. **parva**

Caladenia remota Hopper & A.P. Br. subsp. **remota**

Caladenia varians subsp. *remota* Hopper & A.P. Br. *nom. inval. in* Hoffman & Brown, Orchids of South-West Australia, 2nd edn, p. 36 (1992).

Labellum lamina 13–18 x 11–12 mm. *Column* 12–15 mm tall. (Figure 68)

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 36 [as *Caladenia varians* subsp. *remota*] (1992) and rev. 2nd edn with suppl., p. 36 (1998).

Selected specimen examined. WESTERN AUSTRALIA: Wuraga District, Aug. 1963, Y. Chadwick 2039 (PERTH 00265527).

Distribution and habitat. Confined to thickets beside seasonally wet sites on or adjacent to granite outcrops in pastoral country between Karroun Hill and north of Yalgoo, then west to Eurady Station. (Figure 69A)

Flowering period. August to early September.

Notes. *Caladenia remota* subsp. *remota* is more widespread than subsp. *parva* and is typified by its larger labellum, taller column, and granite rock habitat.

Caladenia remota subsp. **parva** Hopper & A.P. Br., *subsp. nov.*

A subspeciebus typica labello minoribus (9–14 x 8–10 mm) et columna 9–11 mm alta differt.

Typus: Wuraga District, 28°25'S, 116°16'E, Western Australia, August 1963, Y. Chadwick 2039 (*holo:* PERTH 00265527).

Illustration. N. Hoffman & A. Brown, Orchids of South-West Australia, rev. 2nd edn with suppl., p. 424 (1998).

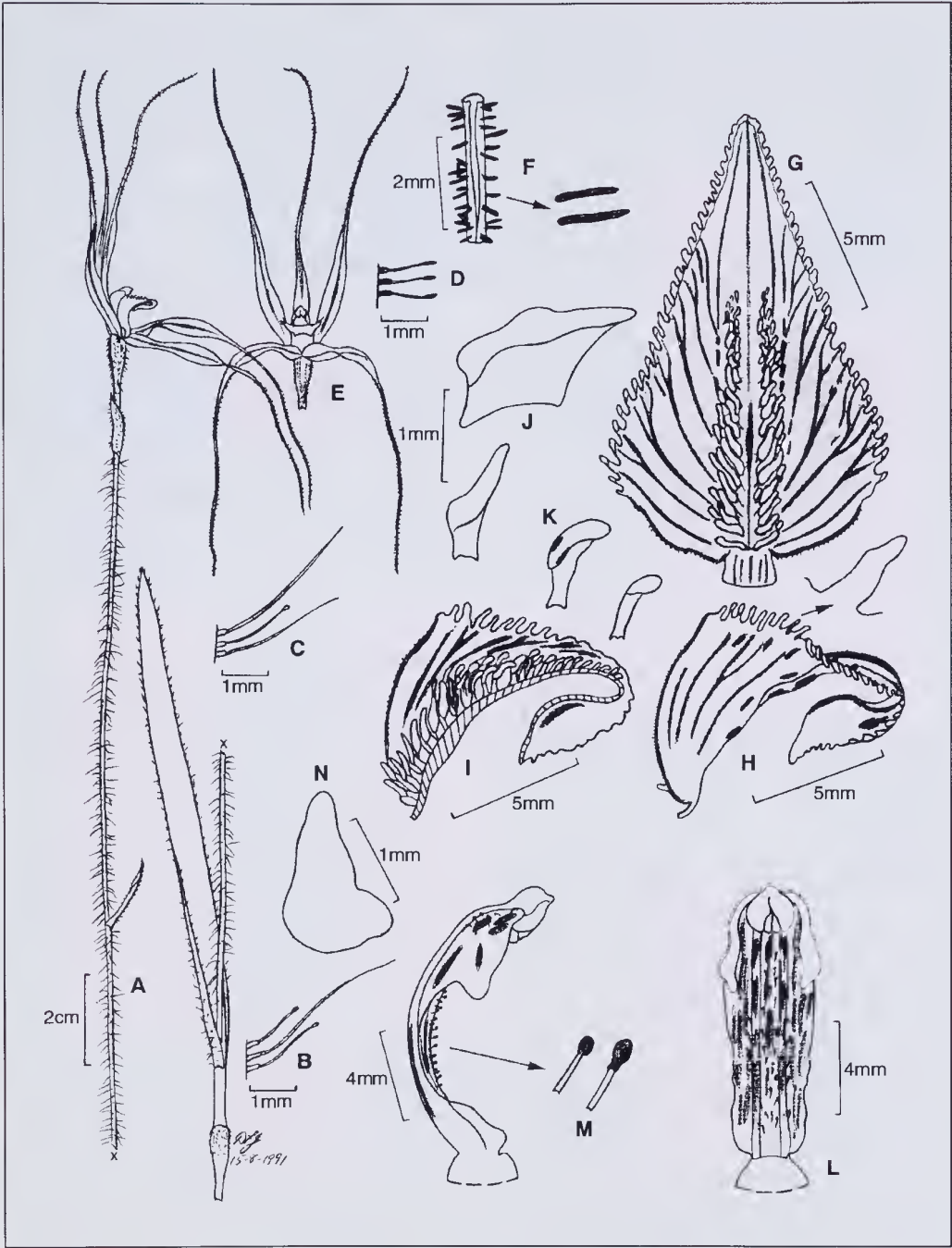


Figure 68. *Caladenia remota* subsp. *remota* from Pullageroo, A.P. Brown 1038. A – plant; B – hairs from lower scape; C – hairs from middle scape; D – glandular hairs on upper scape; E – flower from front; F – hairs from tepal apex; G – flattened labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J – basal labellum lamina callus; K – labellum lamina calli; L – column from front; M – column from side; N – pollinia. Drawn by D.L. Jones.

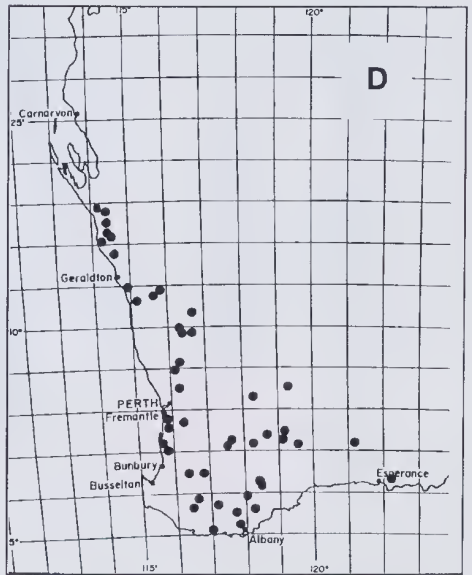
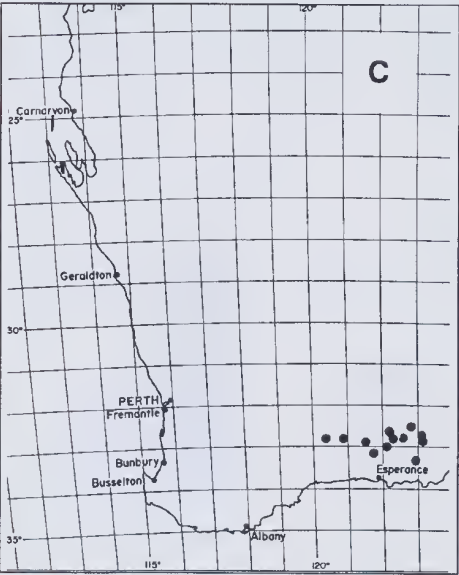
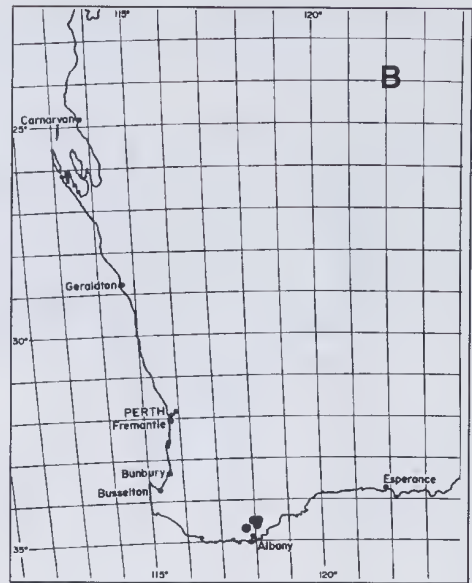
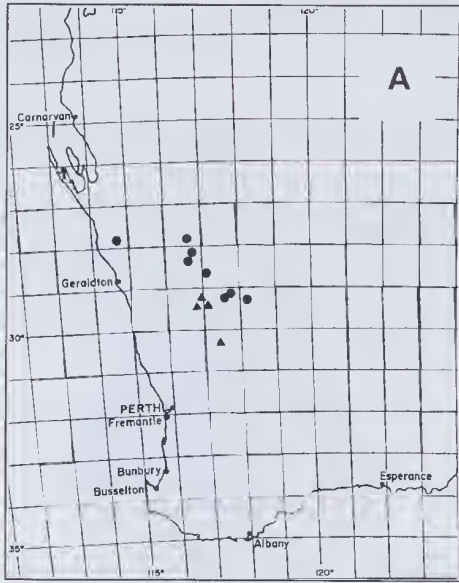


Figure 69. Distribution maps. A – *Caladenia remota* subsp. *remota* ● and *C. remota* subsp. *parva* ▲ ; B – *C. ultima*; C – *C. voigtii*; D – *C. vulgata*.

Labellum lamina 9–14 x 8–10 mm. *Column* 9–11 mm.

Distribution and habitat. A geographically restricted subspecies confined to the Wubin - Perenjori area. Grows in seasonally wet flats in red loam associated with Jam, *Thryptomene* spp. and York Gum. Rarely confined to granite outcrops. (Figure 69A)

Flowering period. Late August to September.

Etymology. Named after the Latin *parvus* (small), alluding to the smaller labellum and column than seen in the typical subspecies.

Notes. *Caladenia remota* subsp. *parva* is a rare taxon (Priority One) known only from the type specimen. It is recommended that further surveys of it be carried out. It has a smaller labellum, and occurs further south-west (in the northern wheatbelt). It also differs in rarely growing on granite outcrops.

Caladenia ultima Hopper & A.P. Br., *sp. nov.*

A speciebus aliis *Caladenia filamentosa* R.Br. affinis floribus dilute luteolis et florescentia postea differt.

Typus: Toll Peak, Stirling Range, 34°22'S, 118°07'E, Western Australia, 17 November 1973, W.P. Stoutamire s.n. (*holo:* PERTH 00272698; *iso:* AD, CBG).

Illustrations. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 52 (1992) and rev. 2nd edn with suppl., p. 52 (1998).

Plant solitary or in loose to dense clumps. *Leaf* erect, linear, 6–15 cm x 2–4 mm, often withered when flowering, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–25 cm tall. *Flowers* 1–3, c. 6–9 cm across, pale lemon yellow with dark maroon lines, spots and blotches; floral odour absent. *Sepals and petals* stiffly held, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a red-brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved or recurved, 6–8 cm x 2–2.5 mm. *Lateral sepals* steeply downcurved, 6–8 cm x 2.5–3 mm. *Petals* spreading to obliquely ascending, sometimes with downcurved apex, 5–7.5 cm x 2–3 mm. *Labellum* white or pale yellow with thick maroon radiating basal lines becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina linear-rhomboidal in outline when flattened, 12–15 x 7–9 mm, 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by obliquely ascending calli, distal margins dentate with white-tipped broad truncate marginal calli decrescent towards the apex. *Lamina calli* in 6–10 pairs in 2 rows extending at least half the length of the labellum, white to creamy yellow, rarely with maroon markings on top, anvil-shaped, the longest c. 1 mm tall, decrescent distally. *Column* c. 10–12 x 3–4 mm, narrowly winged, creamy yellow with maroon blotches, sparsely hirsute with dark glandular trichomes. *Anther* c. 1.5 x 1.5 mm, yellow or greenish-yellow. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 1.5 mm wide. *Capsule* not seen. (Figure 70)

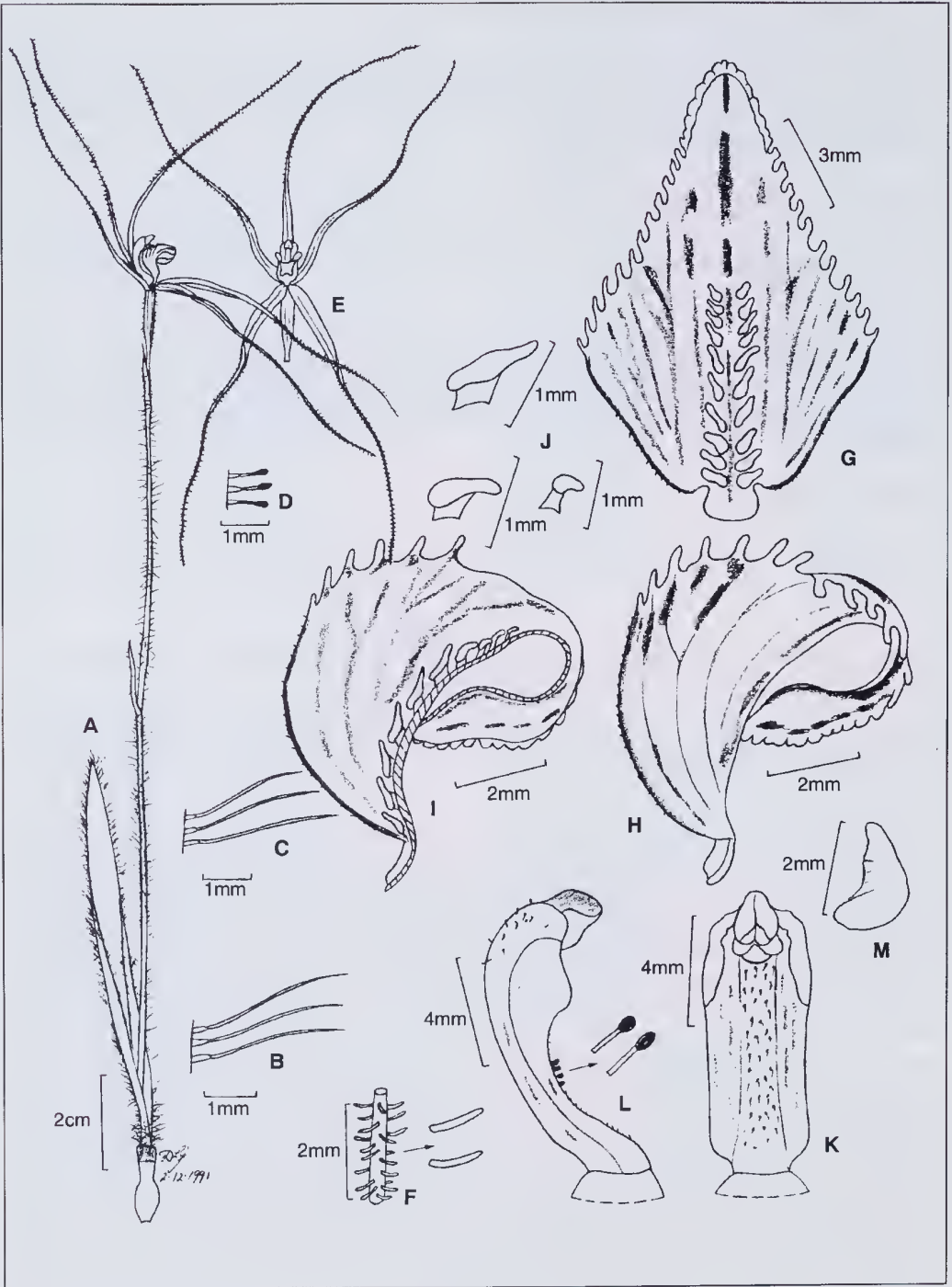


Figure 70. *Caladenia ultima* from south-west of Mount Barker, S.D. Hopper s.n. A – plant; B – hairs from lower scape; C – hairs from middle scape; D – glandular hairs on upper scape; E – flower from front; F – hairs from tepal apex; G – flattened labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J – labellum lamina calli; K – column from front; L – column from side; M – pollinia. Drawn by D.L. Jones.

Selected specimens examined. WESTERN AUSTRALIA: Stirling Range, Oct. 1920, R. Bradshaw & O. Lipfert B1628a (PERTH 00334979); near Spinny's Bridge, E side of Denbarker Rd, 27 Nov. 1991, S.D. Hopper 8271 (PERTH); near Paper Collar (sic) Gully, Chester Pass, Stirling Range National Park, 21 Nov. 1977, W.P. Stoutamire s.n. (PERTH 00272701).

Distribution and habitat. Known only from the Stirling Range–Mount Barker area, favouring low winter-wet situations. At the type locality it was confined with *Eucalyptus patens* to an ecotone of flats lined with paperbarks (*Melaleuca* sp.), and adjacent slopes carrying Jarrah woodland. A little further north, it occurred in extensive winter-wet flats with open woodland of Swamp Yate, Flooded Gum and *E. patens*. Flowers best in the season following summer fire. (Figure 69B)

Flowering period. Late October to December.

Etymology. Named from the Latin *ultimus* (ultimate, last), alluding to the late flowering season of this member of the *Caladenia filamentosa* complex.

Notes. A poorly known species first discovered in the Stirling Range area by Bradshaw and Lipfert in 1920 and not seen again until 1973 when it was found in the same area by Stoutamire. The only known occurrence outside of the Stirling Range is west of Mount Barker but further investigation may show this species to be more widespread in the Jarrah forest. It is one of the last of the *Caladenia filamentosa* complex to flower each year. Only *C. abbreviata* and *C. evanescens* flower at the same time, but both have shorter sepals and petals, and occur in dense heath and Peppermint woodland along the south coast rather than the inland winter-wet flats inhabited by *C. ultima*.

***Caladenia voigtii* Hopper & A.P. Br., sp. nov.**

A *Caladenia cristata* R.S. Rogers floribus pallidioribus leviter majoribus tenentibus vittam latam callorum coalitorum ad basin atro purpureorum vel carmesinorum cuneatorum ad 1.5 mm altorum differt.

Typus: Salmon Gums area, Western Australia, 17 September 1977, D.R. Voigt 36 (*holo:* PERTH 00260703).

Illustrations. S. Hopper, S. van Leeuwin, A. Brown & S. Patrick, Western Australia's Endangered Flora, plate 54 [as *Caladenia* sp. (Esperance) D.R. Voigt 36 'Voigt's Spider Orchid'] (1990); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 142 [as *Caladenia cristata*] (1984), 2nd edn, p. 133 (1992) and rev. 2nd edn with suppl., p. 133 (1998).

Plant solitary or in dense clumps. *Leaf* erect, linear, 5–15 cm x 2–6 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 8–20 cm tall. *Flowers* 1(2), c. 1–2 cm across, pale greenish yellow with pale maroon to purple markings and suffusions; floral odour absent. *Sepals and petals* stiffly held, apex finely acuminate, usually lacking an osmophore (sepals very rarely with a prominently tumescent light to dark brown osmophore 1–2 mm long, consisting of minute densely packed globular sessile glandular cells). *Dorsal sepal* erect to slightly incurved, linear, 1.4–1.8 cm x 2–3 mm. *Lateral sepals* spreading obliquely to vertically downwards, scarcely falcate when flattened, 1.5–1.8 cm x 3–4 mm, linear to narrowly cuneate in basal half in life due to recurved outer margins, narrowing gradually beyond point where marginal recurvature ceases, terminating in a finely acuminate apical 1/6–1/5. *Petals* splayed downwards and backwards with coiled apex, 1.0–1.5 cm x 2–2.5 mm, linear in basal 2/3, gradually narrowing towards apex. *Labellum* prominently 3-lobed with a tiny apical

midlobe, prominently 2-coloured, pale greenish yellow with inconspicuous pale maroon radiating stripes, terminating in a uniformly dark maroon sharply recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina transversely ovate with a small obtuse apex in outline when flattened, 10–12 x 8–12 mm, basal third curving from erect to horizontal, middle third horizontal, apical third horizontal to downcurved terminating in the last 2–3 mm in a sharply recurved apex, margins at widest point moderately curved upwards; lateral lobes erect to horizontal with entire margins; midlobe margins entire. *Lamina calli* aggregated and often fused at the base in a dense central continuous band extending about 2/3 the length of the labellum and stopping about 1 mm before the dark maroon apex, purplish with pale greenish yellow base, erect, linear with a shiny broadly cuneate head, the longest c. 1.5 mm tall. *Column* 10–12 x 7–8 mm, broadly winged, greenish-yellow with maroon suffusions. *Anther* c. 2.5 x 2.5 mm, yellow-green. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2.5 mm wide. *Capsule* not seen. (Figure 65G–L)

Selected specimens examined. WESTERN AUSTRALIA: ENE of Lake King, 6 Sep. 1979, A. Brown s.n. (PERTH 00260681); SSW of Balladonia, 22 Aug. 89, S.D. Hopper 7402 (PERTH 1828789); SSW of Balladonia Motel, 14 Sep. 1980, K.R. Newbey 7312 (PERTH 00334448); Dowak East, 10 Sep. 1978, D.R. Voigt 86pp (PERTH 00260673).

Distribution and habitat. Occurs in scattered populations between the Bremer Range and Balladonia, growing in a range of habitats from shallow soil pockets on granite outcrops, to tall dense shrubland on inland sandplains, and more open shrubland on the margins of salt lakes. Soil ranges from deep sand, to sandy-clays and granitic-loams. (Figure 69C)

Flowering period. August to early October.

Etymology. Named after Mr D.R. Voigt (1936–) of Esperance, farm contractor and dedicated orchid enthusiast and photographer, who has an exceptional knowledge of the orchids of the Esperance region, and who originally discovered this species in 1977. Don has accompanied us on several field trips in search of orchids, and has assisted our research in many other ways.

Notes. A scattered and widespread species (Priority Four) that was, until recently, on the schedule of Declared Rare Flora (Hopper *et al.* 1990) but due to recent discoveries of large populations on secure lands has now been removed from that list. *Caladenia voigtii* usually has solitary pale greenish-yellow flowers marked with maroon to purple lines and suffusions, and a transversely ovate labellum with broadly cuneate-tipped calli often fused at the base. Its nearest ally appears to be *C. cristata*, which differs in its more darkly marked flowers, its cordate shorter labellum with narrow globular-tipped calli that are free to the base, its smaller column, and its centre of distribution some 400 km to the north-west in the Pithara–Miling area.

Caladenia voigtii is also related to *C. brevisura*, *C. incrassata*, and *C. douchiae*, all of which have sepals with an osmophore and short narrow bands of lamina calli. Hybrids have been found between *C. voigtii* and *C. brevisura* where the distributions of the two species overlap. A rare hybrid between *C. voigtii* and *C. microchila* occurs near Dowak north of Salmon Gums.

Caladenia vulgata* Hopper & A.P. Br., *sp. nov.

A *Caladenia denticulata* Lindl. petalis sepalisque plerumque laxis uniformiter cremeis lineis marroninis, et callis exilioribus et elatioribus notis roseis ad apicem differt.

Typus: Kalbarri National Park, 17 km south of Eurardy Homestead, 13.1 km north of Murchison River Bridge, 500 m south-west of Highway, 27°43'S, 114°40'E, Western Australia, 23 August 1983, S.D. Hopper 3330 (*holo*: PERTH 00273600; *iso*: AD, CBG, K).

Illustrations. N. Hoffman & A. Brown, Orchids of South-West Australia, 2nd edn, p. 33 [as *Caladenia varians* subsp. *variens*] (1992) and rev. 2nd edn with suppl., p. 33 (1998).

Plant solitary or in small to large clumps. *Leaf* erect, linear, 5–15 cm x c. 4 mm, pale green, basal third usually irregularly blotched with red-purple. *Scapes* 15–30 cm tall. *Flowers* 1–3, c. 7–10 cm across, cream, with pale maroon lines, spots and blotches; floral odour sometimes faint, like burning metal to putrid. *Sepals and petals* stiffly held near base with a lax or stiffly held apex, linear-lanceolate in basal 1/5–1/4, then abruptly narrowing to a densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 4.5–9 cm x 1.5–3 mm. *Lateral sepals* spreading obliquely downwards, becoming lax and vertical, 4.5–9 cm x 2–4 mm. *Petals* stiffly spreading horizontally, then obliquely descending, 4.5–9 cm x 2–3 mm. *Labellum* cream with dark maroon radiating basal lines, blotches and markings, stiffly articulate on a claw c. 1–1.5 mm wide; lamina linear-rhomboidal to triangular in outline when flattened, 9–15 x 7–11 mm, obscurely to distinctly 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by obliquely ascending calli, distal margins dentate with broadly truncate to triangular forwardly uncinuate cream to dull maroon marginal calli with cream apex, decrescent towards the apex. *Lamina calli* in 8–12 pairs in 2 rows extending up to half the length of the labellum, cream to cream with red-pink apical markings, dull on top, broadly anvil-shaped, the longest c. 1 mm tall, slightly decrescent distally. *Column* 8–12 x 3–6 mm, narrowly winged, pinkish red or cream with fawn to maroon markings, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 2–3 x 2–3 mm, greenish-yellow. *Pollinia* c. 2 mm long, yellow. *Stigma* c. 2–2.5 mm wide. *Capsule* not seen. (Figure 65M–S)

Selected specimens examined. WESTERN AUSTRALIA: Muir Highway, near Lake Muir, 110 km E of Manjimup, 27 Sep. 1983, A. Brown 49 (PERTH 00269794); Hawks Head road just before lookout, c. 3.3 km from Ajana–Kalbarri road, in Kalbarri National Park, 27°48'S, 114°29'E, 21 Aug. 1985, A. Brown & S. van Leeuwen 217b (PERTH 00901237); Cooloomia Nature Reserve, 24 km SSW of Cooloomia Homestead, 27°09'S, 114°14'E, 22 Aug. 1983, S.D. Hopper 3274 (AD, CBG, K, PERTH 00273597); 13 km W of Mt Horner on Mt Horner West Rd, 29°07'S, 114°57'E, 24 Aug. 1983, S.D. Hopper 3354a (PERTH 00334936); 26 km ENE of Wilga siding, 33°39'S, 116°30'E, 6 Oct. 1983, S.D. Hopper 3477 (PERTH 00266884); Strawberry Rocks, 26 km S of Southern Cross, 31°27'S, 119°17'E, 5 Sep. 1984, S.D. Hopper 4054a (PERTH 01935070); Yalgorup National Park, 4.1 km W of Mandurah–Bunbury road on Preston Beach Rd, 32°54'S, 115°12'E, 12 Sep. 1984, S.D. Hopper 4145 (AD, CBG, K, PERTH 00265012); 12 km W of Walpole on South West Highway, 34°59'S, 116°07'E, 7 Oct. 1984, S.D. Hopper 4262 (PERTH 00266949); Great Northern Highway, 1 km NNE of Wubin, 30°06'S, 166°39'E, 23 Aug. 1988, S.D. Hopper 6504 f–h (PERTH 01932500); Yarra Rd, 5.6 km N of Brookton Highway, 32°12'S, 116°26'E, 23 Sep. 1988, S.D. Hopper 6757 (CBG, PERTH 01825704); Peak Charles car park area, 6 Aug. 1978, D.R. Voigt 46pp (PERTH 00265985).

Distribution and habitat. Widespread, from north of Kalbarri to Bunbury and Walpole, then eastwards beyond Esperance. Favours well-watered sandy soils in a range of communities from coastal heath to kwongan, mallee, Tuart woodland, granitic scrub, salt lake margins and ephemeral swamps. (Figure 69D)

Flowering period. August to October.

Etymology. Named from the Latin *vulgatus* (common), alluding to the widespread distribution and local abundance of the species.

Notes. *Caladenia vulgata* is the most widespread member of the Western Australian *C. filamentosa* complex. In the past, it, together with other common species including *C. polychroma*, *C. incensa*, *C. dimidia*, *C. remota*, *C. nobilis* and *C. denticulata* have been referred to as *C. filamentosa* var. *denticulata* (e.g. George 1971; Hoffman & Brown 1984).

Caladenia vulgata is a variable taxon requiring further study. For example, a tall race with long sepals and petals and a putrid odour occurs on the Swan Coastal Plain near Yalgorup. *C. vulgata* is most similar to two other narrow-leaved cream-flowered species with which it is sometimes sympatric. They are *C. pendens*, from which *C. vulgata* differs in its generally shorter sepals and petals (the latter with a stiffly held obliquely descending apex), and its generally smaller labellum, and *C. exilis*, from which *C. vulgata* differs in its larger and broader labellum. *C. vulgata* also may be found growing with *C. nobilis*, which has much larger flowers with a broader labellum and larger column, with *C. hiemalis*, which has shorter scapes, tepals and an earlier flowering season, and with *C. meridionalis*, which also flowers earlier and has more stiffly held petals and sepals with a dark glandular apex, and shorter scapes. On the Swan Coastal Plain, *C. nobilis* and *C. vulgata* may occasionally hybridize when sympatric. Further north, no such hybrids have been recorded.

Northern populations of *Caladenia vulgata* may grow near to *C. incensa*, but the latter differs in its broader leaf, broader tepals, short squat calli, and its preference for heavier (clay-loam) soils. To the north-west of Northampton, *C. vulgata* grows beside and hybridises with *C. elegans*, which differs in its yellow colouration, longer broader tepals, thicker and more squat calli, and its preference for winter-wet clay soils.

In Kalbarri National Park, *Caladenia vulgata* has been recorded hybridising occasionally with *C. wanosa*. Very rare hybrids of *C. vulgata* and *Caladenia drakeoides* have been found near Pithara.

Caladenia xantha Hopper & A.P. Br., *sp. nov.*

A *Caladenia polychroma* Hopper & A.P. Br. tepalis brevioribus aureis apicibus filiformibus fuscis et florescentia praecoci differt.

Typus: Kojonup–Pingrup road, east of Katanning at east end of gravel reserve and rubbish dump, 1.3 km west of airport turnoff, 33°42'S, 117°39'E, Western Australia, 15 August 1985, A.P. Brown 192 (*holo:* PERTH 00905925; *iso:* AD, CANB, K, MEL, NSW).

Illustrations. K. Dixon, B. Buirchell & M. Collins (eds), *Orchids of Western Australia—cultivation and natural history*, colour plate d8 opposite p. 61 [as *Caladenia* species 'Yellow Mini Spider Orchid'] (1989); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 2nd edn, p. 54 (1992) and rev. 2nd edn with suppl., p. 54 (1998).

Plant in small to large clumps, rarely solitary. *Leaf* erect, linear, 8–20 cm x 3–5 mm, pale green, basal third usually irregularly blotched with red-purple. *Scape* 15–26 cm tall. *Flowers* 1 or 2, c. 7–10 cm across, pale to rich yellow, with dark brown lines or blotches; floral odour unknown. *Sepals*

and petals stiffly held, linear-lanceolate in basal 1/4–1/3, then gradually narrowing to a dark brown densely glandular long-acuminate filamentous apex lacking a tumescent osmophore; glandular hairs elongate, cylindrical. *Dorsal sepal* erect and slightly incurved, 3–6 cm x 2–2.5 mm. *Lateral sepals* spreading obliquely downwards, 4–6 cm x 2.5–3 mm. *Petals* spreading obliquely upwards to horizontal or obliquely downwards, 3–5 cm x 2–3 mm. *Labellum* pale yellow to white with radiating dark brown stripes and markings, becoming large irregular spots and blotches towards the recurved apex, stiffly articulate on a claw c. 1 mm wide; lamina rhomboidal in outline when flattened, 10–15 x 7–10 mm, obscurely 3-lobed, erect with entire margins in basal third, nearly horizontal in middle third, apical third sharply recurved, margins at widest point moderately curved upwards and terminated by slightly ascending calli, distal margins serrate with forward facing pale yellow to white marginal calli decrescent towards the apex. *Lamina calli* in 8–14 pairs in 2 rows extending about half the length of the labellum, creamy-white, narrowly columnar with outward curving slender apex, the longest c. 1.5 mm tall, top glistening, not decrescent distally. *Column* 10–13 x 3–5 mm, narrowly winged, creamy yellow with brown blotches, sparsely hirsute with short glandular hairs on outer surface. *Anther* c. 1.5 x 1.5 mm, pale yellow or greenish-yellow. *Pollinia* c. 1.5 mm long, yellow. *Stigma* c. 1.5 mm wide. *Capsule* not seen. (Figure 65T–W)

Selected specimens examined. WESTERN AUSTRALIA: Wandanilling West Rd, between Albany Highway and Beaufort River, 33°32'S, 117°06'E, 15 Aug. 1985, A. Brown 195 (AD, CBG, K, PERTH 00905917); 20 km SE of Moodiarrup on the Collie–Changerup road, 33°43'S, 116°56'E, 28 Sep. 1985, A. Brown 232 (PERTH 00905909); 0.8 km E of Mogumber on road to New Norcia, 31°02'S, 116°03'E, 17 Sep. 1983, R.J. Cranfield 4131 (PERTH 00335401); Brookton Highway, just W of Beverley turnoff, 14 Aug. 1960, A.S. George 987 (PERTH 00270717); 3 km S of Mayanup, Bridgetown turnoff on Boyup–Cranbrook road, 33°27'S, 116°27'E, 10 Sep. 1985, S.D. Hopper 4535 (PERTH 00903337); 2 km W of Butterworth Rd on Nyabing Rd, 500 m E of Katanning, 33°41'S, 117°34'E, 11 Sep. 1985, S.D. Hopper 4546 (PERTH 00903345); Great Southern Highway, c. 14 km S of Narrogin, 33°02'S, 117°13'E, 26 Aug. 1986, S.D. Hopper 5212 (PERTH 01191926); Broomehill Golf Course, 27 Aug. 1975, B.R. Maslin 3762 (CANB, PERTH 00270288).

Distribution and habitat. Ranges from Mogumber to Kendenup, mostly in Wandoo and Rock Oak woodlands on sandy clays and lateritic loams. (Figure 71A)

Flowering period. Late July to early September.

Etymology. Named from the Greek *xanthos* (yellow), alluding to the floral colouration.

Notes. *Caladenia xantha* is an uncommon species of the western wheatbelt Wandoo and Rock Oak woodlands, occasionally extending into Jarrah forest. It is similar to *C. polychroma* and *C. dimidia*, differing in its consistently pale to rich yellow flowers, its shorter petals and sepals with a dark brown apex, its white calli on a yellow to white labellum lamina, and its somewhat earlier flowering season. *C. xantha* also might be confused with yellow variants of *C. denticulata*, but again differs in its shorter petals and sepals that are more stiffly held, the petals often upswept, in its shorter yellow to cream labellum, and its preference for higher drier sites with better-drained soils. *C. xantha* grows with the rare *C. luteola*, but differs in its earlier flowering season, and smaller flowers.

Caladenia xantha hybridizes with *C. polychroma* and with *C. hiemalis* at some sites. Hybrids with other species are not known, possibly because of the early flowering season of *C. xantha*.

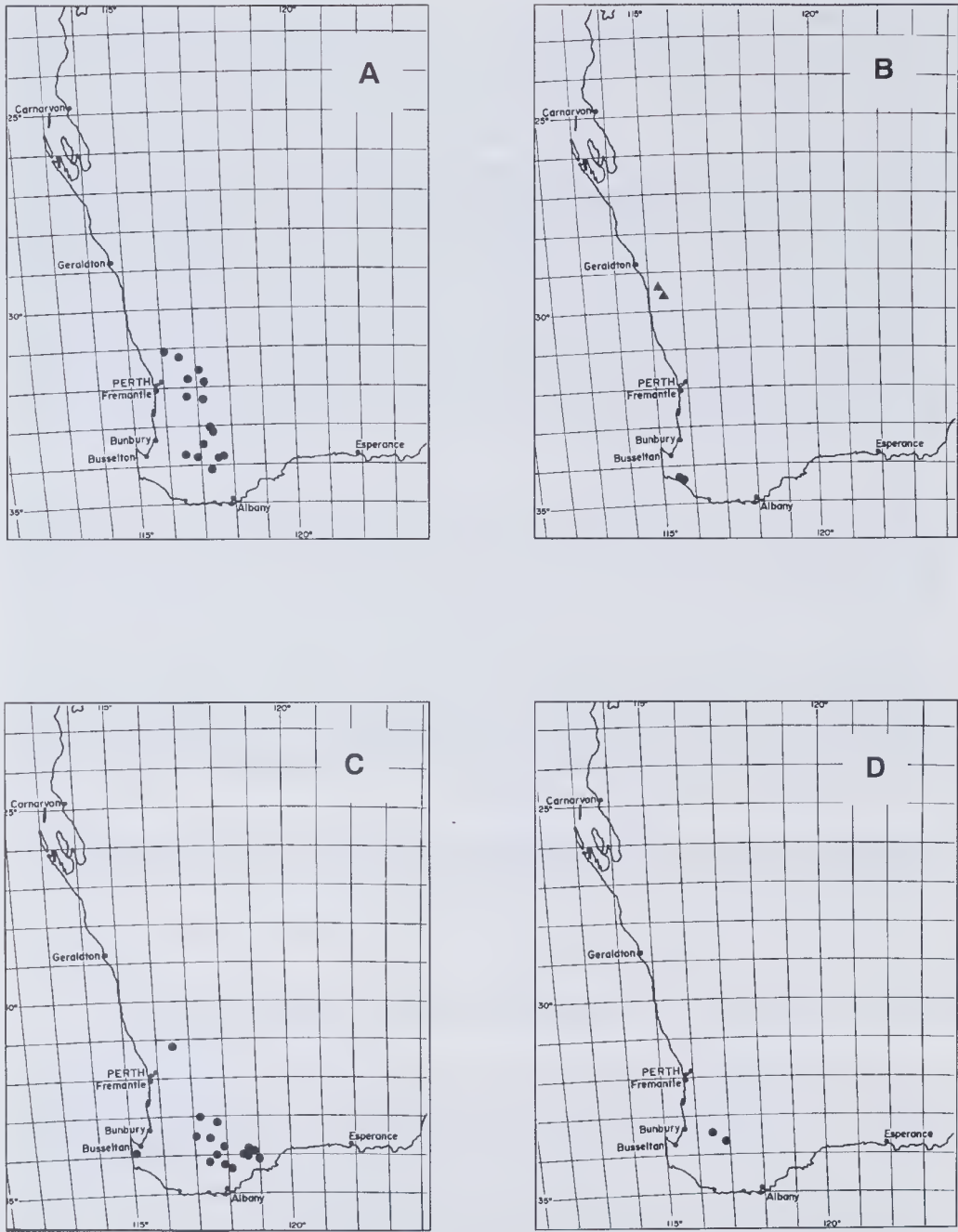


Figure 71. Distribution maps. A – *Caladenia xantha*; B – *Caladenia x aestantha* ● and *C. x coactescens* ▲ ; C – *C. x cala*; D – *C. x eludens*.

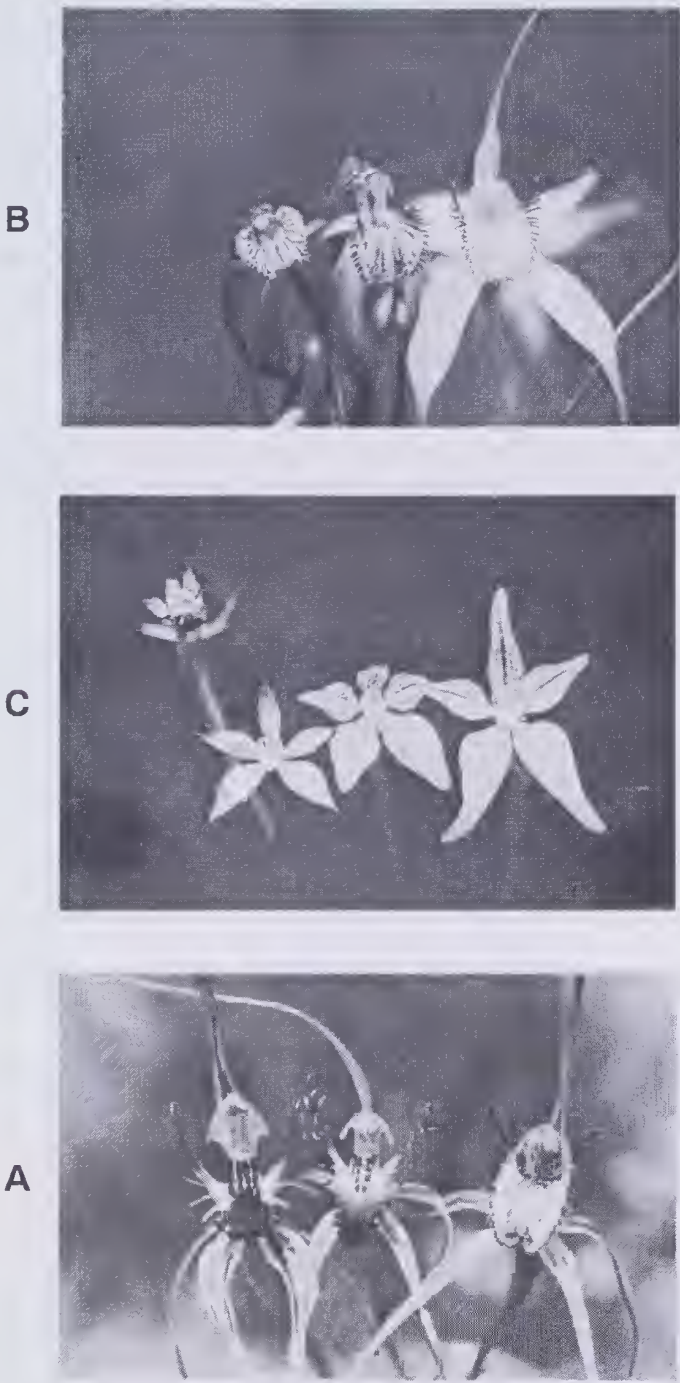


Figure 72. A – *Caladenia x aestantha* (centre) with parental taxa *C. corynephora* (left) and *C. serotina* (right) from Scott River, photograph by A.P. Brown; B – *C. x eludens* (centre) with parental taxa *C. chapmanii* (left) and *C. splendens* (right) from the Moodiarrup area, photograph by S.D. Hopper; C – *C. x erminea* with parental taxa *C. marginata* (left) and *C. flava* (right) from the Gracetown area, photograph by S.D. Hopper.

Hybrids

Caladenia x aestantha Hopper & A.P. Br., *hyb. nov.*

A *Caladenia corynephora* A.S. George floribus palentioribus et sepalis lateralibus longioribus clavatis apicalibus deficientibus differt.

Typus: edge of Scott River Plains, Western Australia, 3 December 1986, A.P. Brown 548 (*holo*: PERTH).

Differs from *Caladenia corynephora* A.S. George in its paler floral colouration and its longer lateral sepals (to 5 cm) lacking an osmophore (Figure 72A, middle flower).

Distribution and habitat. *Caladenia x aestantha* is of restricted occurrence along the south coast of Western Australia between Albany and Augusta. It is found in moist sites, often amongst scattered paperbarks, growing with *C. corynephora* and *C. serotina*. (Figure 71B)

Flowering period. Late November to January.

Etymology. Named from the Latin *aestas* (summer), and *anthus* (flower), alluding to the summer flowering period of this hybrid.

Notes. A rare but distinctive hybrid between *Caladenia corynephora* and *C. serotina*, represented in herbaria by the type collection only.

Caladenia x cala Hopper & A.P. Br., *hyb. nov.*

A *Caladenia longicauda* Lindl. labello late triangulari apice atro marronino differt.

Typus: c. 8 km east of Bullaring on Gorge Rock Rd, Western Australia, 6 September, R.L. Heberle *s.n.* (*holo*: PERTH 00255602).

Illustrations. W. Nicholls, *Orchids of Australia*, plate 266 (1969); W.R. Elliot & D.L. Jones, *Encyclopaedia of Australian Plants Suitable for cultivation*, Vol. 2, p. 403 (1982).

Differs from *Caladenia longicauda* Lindl. in its broadly triangular labellum with a dark maroon apex.

Selected specimens examined. WESTERN AUSTRALIA: Jerdacuttup River, SW of Ravensthorpe, Oct. 1968, V.M. Bennett *s.n.* (PERTH 00309877); c. 10 km from Lake Grace on road to Karlgarin, 7 Sep. 1978, R. Heberle *s.n.* (PERTH 00255599); Jerramungup townsite, 3 Oct. 1985, R. Heberle for R. Peakall 0046 (PERTH 00560928); Gordon River bridge, 3 Oct. 1985, R. Heberle for R. Peakall 0048 (PERTH 00560723); 5 km S of Jerramungup, 33°58'S, 118°56'E, 5 Oct. 1984, S.D. Hopper 4212 (PERTH 00307033); Gairdner River Nature Reserve, c. 17 km NE of Jerramungup, 33°50'S, 118°49'E, 24 Sep. 1988, S.D. Hopper 6782 (PERTH 1670115); 23.6 km NW of Kojonup to Darkan, 21 km SE of Moodiarup, Arthur River, 26 Sep. 1987, G.J. Keighery 9158 (PERTH 00849936); Manmanning, 16

Sep. 1970, *J. Kruiskamp s.n.* c (PERTH 00848824); 0.4 km N along Albany Highway from Gordon River bridge, 34°14'S, 117°30'E, 4 Oct. 1985, *R. Peakall* 0060 (PERTH 00561053).

Distribution and habitat. Widespread but rare in the western and southern wheatbelt. Inhabits open Wandoo woodland, mallee heath and Rock Oak thickets adjacent to creeklines and granite outcrops. (Figure 71C)

Flowering period. September to October.

Etymology. Named from the Greek *calo* (beautiful), alluding to the striking flowers of this robust hybrid.

Notes. This is one of the most beautiful *Caladenia* hybrids, derived from a *C. falcata* x *C. longicauda* cross. It often forms clumps through vegetative reproduction and in some areas can be quite common. There are many similar hybrids derived from crosses between other members of the *C. longicauda* or *C. patersonii* and the *C. dilatata* species complexes. In Western Australia, the *C. dilatata* species complex includes *C. falcata*, *C. attingens*, *C. longifimbriata*, *C. integra* and *C. exstans*.

Caladenia* x *coactescens Hopper & A.P. Br., *hyb. nov.*

A *Caladenia crebra* A.S George sepalis lateralibus longioribus et labello pallentiori callis minus dense aggregatis differt.

Typus: Brand Highway, south of Dongara, Western Australia, August 1980, *W.P. Stoutamire s.n.* (*holo:* PERTH 00254134).

Illustration. K. Dixon, B. Buirchell & M. Collins (eds) *Orchids of Western Australia – cultivation and natural history*, plate 2d (1989).

Differs from *Caladenia crebra* A.S George in its longer lateral sepals and its paler labellum with less densely aggregated calli.

Selected specimen examined. WESTERN AUSTRALIA: 11 km NW of Arrowsmith Hill along Brand Highway, 29°31'S, 115°03'E, 20 Sep. 1983, *S.D. Hopper* 3393 (PERTH 00255572).

Distribution and habitat. Of scattered occurrence in near coastal areas between Dongara and Jurien Bay. Favours shallow calcareous sand over limestone, often in association with *Eucalyptus erythrocorys*. (Figure 71B)

Flowering period. August to September.

Etymology. Derived from the Latin *coactus* (felted), alluding to the broad band of small aggregated calli on the labellum lamina.

Notes. *Caladenia* x *coactescens* is a distinctive and very rare hybrid confined to woodlands of *Eucalyptus erythrocorys* south of Dongara. It is derived from crosses between *C. crebra* and *C. longicauda*.

Caladenia x eludens* Hopper & A.P. Br., *hyb. nov.

A *Caladenia longicauda* Lindl. floribus minoribus, fimbria labelli brevior et callis serialibus duobus longitudinalibus aggregatis differt.

Typus: 26 km east-north-east of Wilga, 25 km north-north-east of Boyup Brook, 33°39'S 116°30'E, Western Australia, 6 Oct. 1983, *S.D. Hopper* 3476 (*holo*: PERTH 00250287; *iso*: CBG!).

Differs from *Caladenia longicauda* Lindl. in its smaller flowers; its shorter labellum fringe; and its calli aggregated into two longitudinal rows. (Figure 72B)

Selected specimens examined. WESTERN AUSTRALIA: 20 km SE of Moodiarrup on the Collie-Changerup road, 33°43'S, 116°56'E, 28 Sep. 1985, *A. Brown* 234 (PERTH 00905887); 26 km ENE of Wilga, 33°39'S, 116°30'E, 2 Oct. 1984, *E. Chapman s.n.* (AD, CANB, K, MEL, PERTH 00256285).

Distribution and habitat. Known only from the Boyup Brook–Collie area in Western Australia. Favours open Wandoo woodland amongst scattered Rock Oak in deep sandy soils. (Figure 71D)

Flowering period. September to October.

Etymology. Named from the Latin *eludo* (avoid, evade, frustrate, baffle), alluding to the extreme rarity of this hybrid.

Notes. *Caladenia x eludens* is one of the rarest hybrids known to us, derived from a *C. chapmanii* x *C. splendens* cross. There are very few other collections of hybrids derived from crosses between members of the *C. filamentosa* and *C. longicauda* species complexes in Western Australia.

Caladenia x enigma* Hopper & A.P. Br., *hyb. nov.

A *Caladenia x ornata* Hopper et A.P. Br. lamina labelli vix trilobata, marginibus fimbriato-serratis segmentibus fimbriatis ad 3 mm longis, et callis decrescentibus in magnitudine sed extensis fere ad apicem laminae differt.

Typus: 0.4 km west along track parallel with railway line from tennis club, Kulikup, 33°50'S, 116°40'E, Western Australia, 4 October 1985, *R. Peakall* 0068 (*holo*: PERTH 00561088).

Illustration. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 72 [as *Caladenia* sp.] (1984).

Differs from *Caladenia x ornata* Hopper & A.P. Br. in its labellum lamina scarcely 3-lobed, the margins fimbriate-serrate with fringe segments to 3 mm long, and its calli decreasing in size but extending almost to the apex of the lamina.

Selected specimens examined. WESTERN AUSTRALIA: 7.5 km NNE of Mount Barker on North Carbarup Rd, 34°34'S, 117°42'E, 30 Sep. 1983, *S.D. Hopper* 3402 (PERTH 00250325); on Flora and Fauna Road c.12 km NNE of Chowerup Mill, 33°59'S, 116°48'E, 6 Oct. 1983, *S.D. Hopper* 3489 (PERTH 01711059); 3.4 km W of Drummond Track on old Ongerup road, 33°48'S, 119°28'E, 4 Oct.

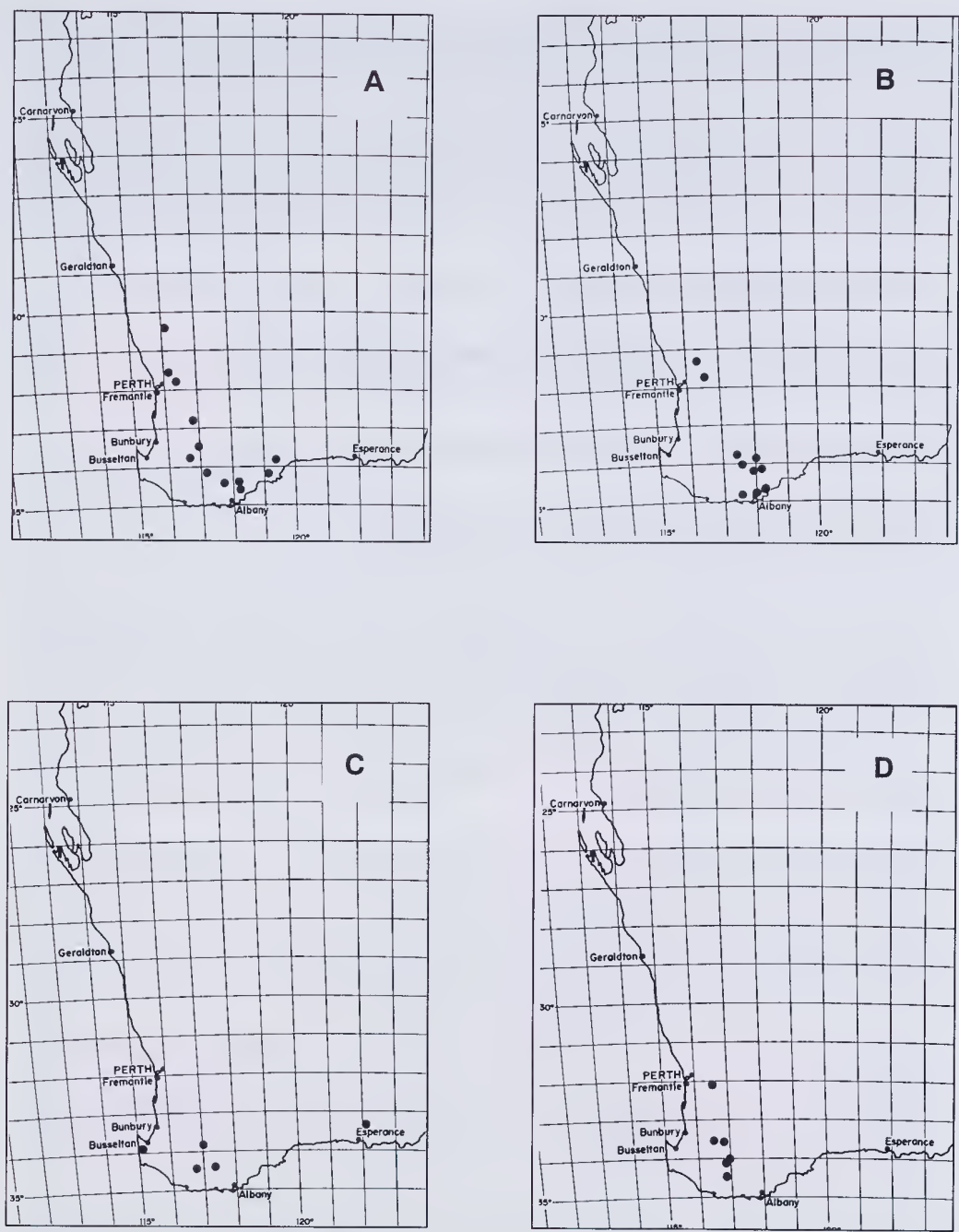


Figure 73. Distribution maps. A – *Caladenia x enigma*; B – *C. x ericksoniae*; C – *C. x erminea*; D – *C. x exserta*.

1984, *S.D. Hopper* 4191 (PERTH 00254649); Bremer River crossing on Devils Rd, 34°13'S, 119°09'E, 5 Oct. 1984, *S.D. Hopper* 4220 (PERTH 00254231); 0.4 km W along track parallel with railway line from tennis club, Kulikup, 33°50'S, 116°40'E, 4 Oct. 1985, *R. Peakall* 0068 (PERTH 00561088).

Distribution and habitat. Found throughout the western and southern wheatbelt between Watheroo and Munglinup, growing with *Caladenia longicauda* and *C. barbarossa*. Occurs in Wandoo woodlands, dense sheoak thickets along river courses and in York Gum woodlands. Soils are usually clay-loams. (Figure 73A)

Flowering period. September to October.

Etymology. Named from the Latin *enigmus* (puzzle), alluding to past mystery and confusion as to whether or not the taxon was a hybrid (e.g. Hoffman & Brown 1984, pp. 72–75).

Notes. *Caladenia x enigma* is a hybrid of *C. longicauda* and *C. barbarossa*.

Caladenia x ericksoniae Nicholls, *Victorian Naturalist* 66: 214, f.E (1950). *Type:* Bolgart, Western Australia, 27 September 1949, *R. Erickson s.n. (holo: MEL!)*.

Illustrations. R. Erickson, *Orchids of the West*, 2nd edn, plate 28 No. 3 (1965); W. Nicholls, *Orchids of Australia*, plate 244 (1969); N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 90 (1984); C. Woolcock & D. Woolcock, *Australian Terrestrial Orchids*, plate 17B (1984); D. Jones, *Native Orchids of Australia*, p. 117, top left and centre drawings (1988); M. Hodgson & R. Paine, *Field Guide to Australian Orchids*, p. 64 (1989).

Differs from *Caladenia x lavandulacea* in its smaller labellum with fewer, thicker calli and marginal teeth; and its shorter petals and sepals.

Other specimens examined. WESTERNAUSTRALIA: Paul's Valley, between Kojonup and Cranbrook, 28 Sep. 1931, *Anon. s.n.* (PERTH 00240095); Bolgart, 1 Sep. 1946, *Anon. s.n.* (PERTH 00239631); Nightwell Rd, 12.5 km ESE of Chester Pass Rd, 34°13'S, 118°22'E, 14 Oct. 1986, *A. Brown* 467 (PERTH 00928623); 5 miles [8 km] W of Albany on Elleker road, 35°01'S, 117°48'E, 2 Oct. 1971, *A.S. George & L. Byrne* ASG 11102 (PERTH 00239615); Albany, 35°01'S, 117°53'E, 11 Oct. 1978, *R. Heberles* s.n. (PERTH 00239623); Water Reserve No. 21748, S of Borden township, 34°05'S, 118°15'E, 11 Sep. 1982, *S.D. Hopper* 2563a (PERTH 01932470 CBG); SE side of junction of Two Peoples Bay Rd and Sinker Reef Rd, 0.5 km S of Two Peoples Bay on Two Peoples Bay Nature Reserve, 34°58'S, 118°10'E, 30 Sep. 1983, *S.D. Hopper* 3411 (PERTH 0039194); upper reaches of Pappa Colla Gully, c. 9 km NNW of Bluff Knoll, Stirling Range, 14 Sep. 1986, *G.J. Keighery* 8384 (PERTH 00858242); *s. loc.*, *R. Oliver* s.n. (PERTH 00239607); 7 miles [12 km] E of Mt Brown, York, 5 Sep. 1909, *L.O. Sargent* s.n. (PERTH 00239712); Tenterden, 11 Oct. 1977, *A. Wilson* s.n. (PERTH 00249424).

Distribution and habitat. A common widespread hybrid of scattered occurrence between Albany and York. Occupies a range of habitats including Wandoo, Jam and sheoak woodlands, shrublands adjacent to rivers and seasonal creeks and granite outcrops. (Figure 73B)

Flowering period. August to October.

Notes. Most previous authors have followed Nicholls (1950) in believing *Caladenia x ericksoniae* to be a species. However, Heberle (1982) and Hoffman & Brown (1984) were the first to suggest its hybrid status, a view confirmed by Clements (1989) and ourselves. The type is from an area between the margins of known distribution of both *C. cairnsiana* and *C. pachychila*, but we suspect it to be a *C. filifera* x *C. cairnsiana* cross. There are similar hybrids between *C. cairnsiana*, *C. pachychila* and other members of the *C. filamentosa* complex found from Kalbarri to Esperance.

Caladenia x erminea* Hopper & A.P. Br., *hyb. nov.

A Caladenia flava R.Br. floribus cremeis minoribus pilis fuscis subter petalis sepalisque differt.

Typus: Wittenoom Hills, 33°28'S, 122°08'E, Western Australia, 8 October 1985, *S.D. Hopper* 4687 (*holo:* PERTH 00843199; *iso:* CBG!).

Differs from *Caladenia flava* R.Br. in its smaller cream flowers with dusky hairs on the underside of the petals and sepals. (Figure 71D)

Selected specimens examined. WESTERN AUSTRALIA: Muir Highway, 9 Nov. 1980, *A. Brown s.n.* a,b (PERTH 00249432); E side of Frankland River, Muir Highway, 34°29'S, 116°54'E, 2 Nov. 1977, *A.S. George* 15020d (PERTH 00848743); Leeuwin–Naturaliste National Park, 1.5 km N of Gracetown on Cowaramup Bay road, 33°51'S, 114°59'E, 4 Oct. 1983, *S.D. Hopper* 3426 (CBG, PERTH 00249874).

Distribution and habitat. Widespread but rare between Esperance and the Leeuwin–Naturaliste ridge. Found in moist sites adjacent to winter-wet swamps and granite outcrops. (Figure 73C)

Flowering period. September to November.

Etymology. Derived from the Latin *ermineus* (cream-coloured, white with a yellow tinge), alluding to the floral colouration.

Notes. *Caladenia x erminea* is an uncommon colonial hybrid of *C. flava* and *C. marginata*. Individual colonies may extend over several square metres.

Caladenia x exserta* Hopper & A.P. Br., *hyb. nov.

A Caladenia longicauda Lindl. scapis brevioribus et floribus minoribus labello angustiore plerumque exserto tum recurvo ad apicem plerumque atro rubrum differt.

Typus: 26 km east-north-east of Wilga Siding, 25 km north-north-east of Boyup Brook, 33°39'S, 116°30'E, Western Australia, 6 October 1983, *S.D. Hopper* 3480 (*holo:* PERTH 00254169; *iso:* AD!, CBG!, K!).

Illustrations. D. Jones, Native Orchids of Australia, p. 135 [as *Caladenia uliginosa*] (1988); K. Dixon, B. Buirchell & M. Collins (eds), Orchids of Western Australia – cultivation and natural history, colour plates b & c opposite p. 15 (1989).

Differs from *Caladenia longicauda* Lindl. in its shorter scapes and its smaller flowers with a

narrower labellum usually thrust well forward before recurving at the apex, which is often dark red.

Selected specimens examined. WESTERN AUSTRALIA: Frankland, *s.d.*, *J. Atkinson s.n.* (PERTH 00912808); 31 km N of Frankland on Kojonup road, 34°11'S, 116°59'E, 3 Oct. 1978, *A.S. George* 15252 (PERTH 00290432); 23 km NNE of Boyup Brook, 23 km ENE of Wilga siding, 33°38'S, 116°29'E, 6 Oct. 1983, *S.D. Hopper* 3470 (AD, CBG, PERTH 00290408); 0.6 km N of Muirs Highway at site of old Muirs Bridge, 10 km WNW of Rocky Gully, 34°29'S, 116°54'E, 8 Oct. 1983, *S.D. Hopper* 3525 (PERTH 00249904).

Distribution and habitat. Occurs in winter-wet flats and damp sites adjacent to rivers and creeks between York, Narrogin and Rocky Gully. It is especially common in areas burnt by summer fires. (Figure 73D)

Flowering period. September to November.

Etymology. Derived from the Latin *exsertus* (protruding), alluding to the disposition of the labellum.

Notes. *Caladenia x exserta* is a common hybrid of *C. longicauda* and *C. uliginosa*.

Caladenia x exoleta Hopper & A.P. Br., *hyb. nov.*

A *Caladenia roei* Benth. labello coloratiore marginibus dentatis et sepalis lateralibus longioribus. A *Caladenia x lavandulacea* R. Rogers callis robustioribus paucisque differt.

Typus: 6 km north-east of Toolibin, 800 m west of Wedin North Rd on Wickepin–Harrismith road, 32°55'S, 117°42'E, Western Australia, 7 September 1984, *S.D. Hopper* 4119 (*holo:* PERTH 00250805).

Illustration. N. Hoffman & A. Brown, *Orchids of South-West Australia*, 1st edn, p. 136 [as *Caladenia* aff. *lavandulacea*] (1984).

Differs from *Caladenia roei* Benth. in its more colourful labellum with dentate margins and its longer lateral sepals (to 5 cm). Differs from *C. x lavandulacea* R. Rogers in its more robust and fewer calli.

Selected specimens examined. WESTERN AUSTRALIA: N of Goomalling, Wongan Hills turnoff, 9 Aug. 1959, *A.S. George* 68 (PERTH 00239674); in the SW corner of Muntadgin Wheatbin, 31°45'S, 118°33'E, 14 Sep. 1985, *S.D. Hopper* 4592 (PERTH 01670107); Bushfire Rock, c. 45 km E of Hyden, 32°27'S, 119°21'E, 4 Sep. 1986, *S.D. Hopper* 5457 (PERTH 01198327; Tincurrin, Sep. 1958, *J. Tonkinson s.n.* (PERTH 00332801).

Distribution and habitat. Widespread but rare in the central and southern wheatbelt. Occurs in mallee, Jam and Yate woodlands, inland shrublands, and Rock Oak thickets surrounding granite outcrops and along river courses. Soils are sandy-clays and loams. (Figure 74A)

Flowering period. August to October.

Etymology. Derived from the Latin *exoletus* (full grown, mature), alluding to the robust calli on the

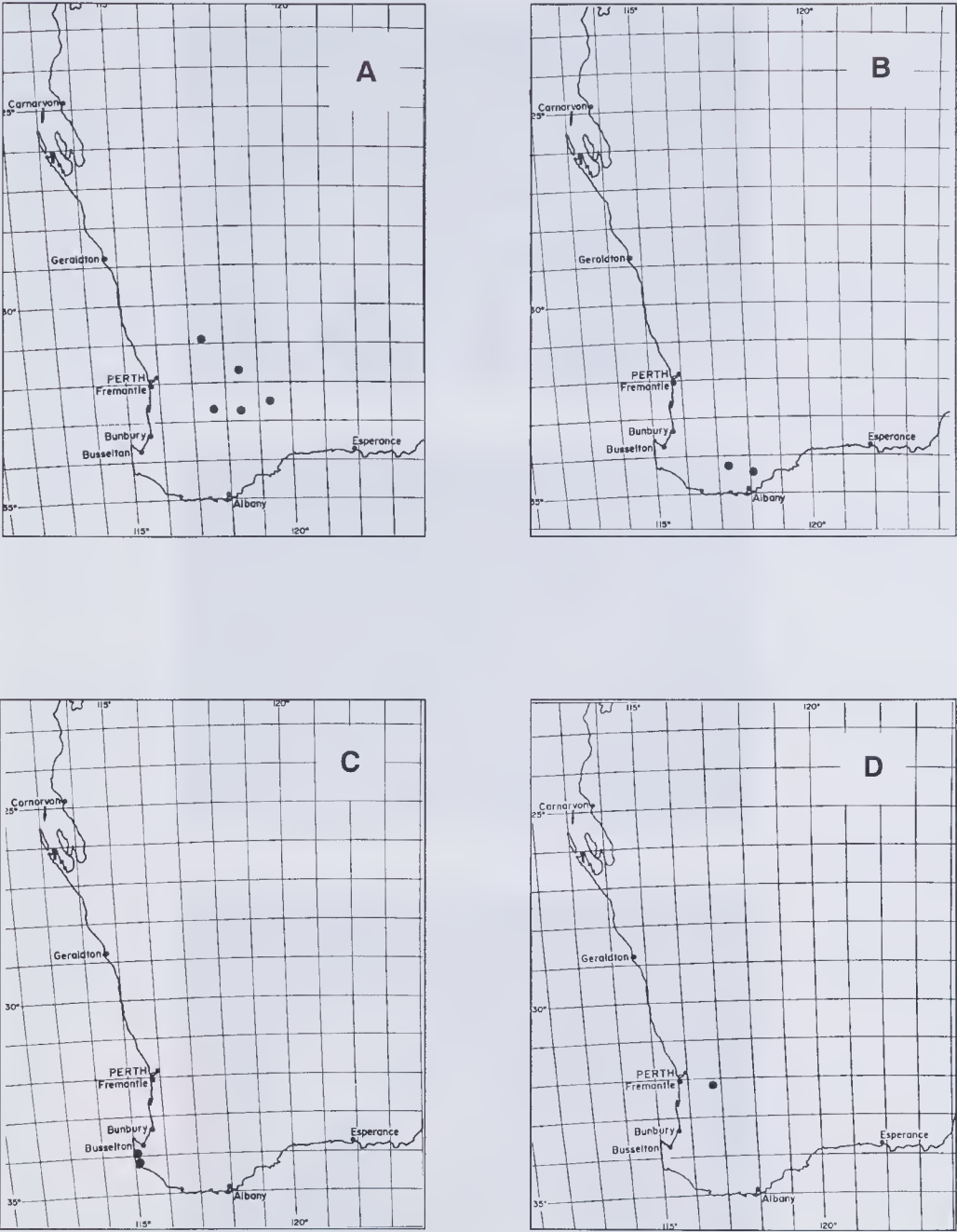


Figure 74. Distribution maps. A – *Caladenia x exoleta*; B – *C. x hypata*; C – *C. x idiasstes*; D – *C. x lavandulacea*.

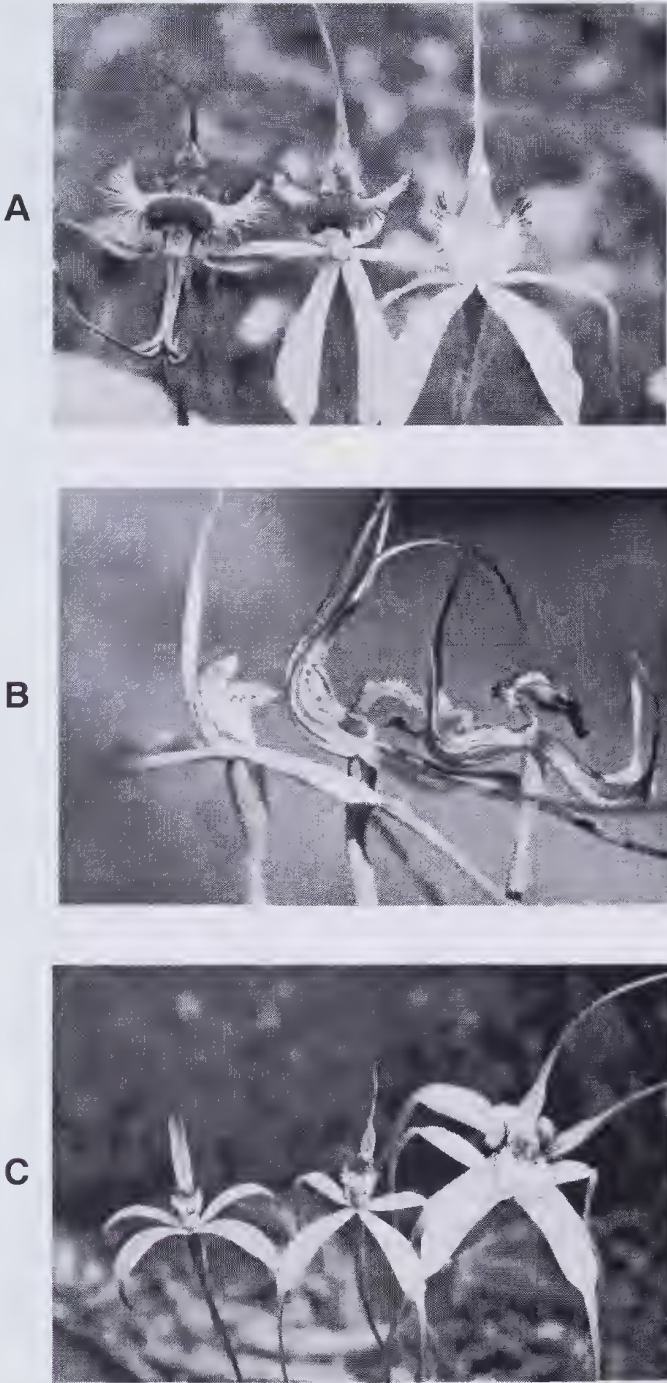


Figure 75. A – *Caladenia x hypata* (centre) with parental taxa *C. longicauda* (right) and *C. lobata* (left) from the Muir Highway, photograph by S.D. Hopper; B – *C. x resupina* (centre) with parental taxa *C. horistes* (left) and *C. multiclavia* (right) from south of Jerramungup, photograph by S.D. Hopper; C – *C. x suffusa* (centre) with parental taxa *C. hirta* (left) and *C. longicauda* (right) from the Northam area, photograph by A.P. Brown.

labellum.

Notes. *Caladenia x exoleta* is a hybrid derived from crosses between *C. roei* and *C. dimidia*. There are other similar hybrids derived from crosses between *C. roei* and other Western Australian members of the *C. filamentosa* complex. The photo in Hoffman & Brown (1984) labelled as *C. aff. lavandulacea* has the larger, more robust calli of *C. x exoleta*.

Caladenia x hypata* Hopper & A.P. Br., *hyb. nov.

A *Caladenia longicauda* Lindl. et *Caladenia x cala* Hopper et A.P. Br. labello complantiore latiore callis numerosioribus gracilibus ferentibus lato-fasciatis differt.

Typus: Rocky Gully, Western Australia, 11 October 1978, *R. Heberle s.n. (holo: PERTH 00266590)*.

Differs from *Caladenia longicauda* Lindl. and *C. x cala* Hopper & A.P. Br. in its broader flatter labellum with more numerous finer calli in a broader band. (Figure 75A)

Selected specimens examined. WESTERN AUSTRALIA: Muir Bridge, 10 Oct. 1980, *A. Brown s.n. (PERTH 00779652)*; E side of Frankland River, Muir Highway, 34°29'S, 116°54'E, 2 Nov. 1977, *A.S. George 15019 (PERTH 00290939)*; Frankland River, 16 Sep. 1958, *L. Higgins s.n. b (PERTH 00912794)*.

Distribution and habitat. Known from a few sites in the Frankland, Rocky Gully area and to the east of Mount Barker. Grows with *Caladenia lobata* and *C. longicauda* in Jarrah/Marri forest adjacent to river courses and winter-wet swamps. (Figure 74B)

Flowering period. September to November.

Etymology. Derived from the Greek *hypatos* (uppermost, highest), alluding to the large robust and beautiful flowers of this spectacular hybrid.

Notes. *Caladenia x hypata* is a robust and colourful hybrid between *C. lobata* and *C. longicauda*. It has been rarely seen and does not appear to flower every year. Known occurrences were at sites searched the first spring after summer fire.

Caladenia x idiaestes* Hopper & A.P. Br., *hyb. nov.

A *Caladenia latifolia* R. Br. labello longiore et petalis sepalisque longioribus differt.

Typus: Yallingup, Western Australia, 8 October 1967, *A.S. George 9203 (holo: PERTH 01706977)*.

Illustration. R. Bates & J. Weber, *Orchids of South Australia*, plate 51 (1990).

Differs from *Caladenia latifolia* R. Br. in its longer labellum and its longer petals and sepals.

Selected specimen examined. WESTERN AUSTRALIA: Yallingup, 8 Oct. 1967, *A.S. George 9203 (PERTH 01706977)*.

Distribution and habitat. Known from a few sites between Cape Leeuwin and Cape Naturaliste, growing in Peppermint woodland. Soils are calcareous sands. (Figure 74C)

Flowering period. September to October.

Etymology. Derived from the Greek *idios* (private, separate, distinct), alluding to the very distinct morphology of flowers of this hybrid.

Notes. *Caladenia x idiaestes* is an extremely rare hybrid of *C. gardneri* and *C. latifolia*.

Caladenia x lavandulacea R. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 51: 11 (1927). *Type:* between York and Narrogin, Western Australia, September 1926, W. Dedman s.n. (*holo:* AD!).

Illustrations. B. Rye & S. Hopper, *Guide to the Gazetted Rare Flora of Western Australia*, Dept Fish. Wildl. Rept No. 42, p. 55 (1981).

Differs from *Caladenia douthiae* O. Sargent in its more colourful labellum 10–13 mm wide with serrate margins and its larger sepals to 4–5 cm long. Differs from *C. x exoleta* and from *C. x ericksoniae* in its smaller more numerous calli, its finer more numerous segments fringing the labellum lamina, and its usually darker labellum.

Other specimen examined. WESTERN AUSTRALIA: s. loc., s.d., Anon. s.n. (PERTH 00239666).

Distribution and habitat. *Caladenia x lavandulacea* is known only from the type location between York and Narrogin. (Figure 74D)

Flowering period. August to October.

Notes. Until Hoffman & Brown (1984), Jones (1988) and Clements (1989) proposed it was a hybrid, *Caladenia x lavandulacea* was regarded by many authors to be an obscure species known only from the single plant of the type collection (Rogers 1927; Pelloe 1930; Erickson 1965; George 1971; Clements 1982). Similar hybrids are known derived from crosses between *C. douthiae*, *C. brevisura*, *C. incrassata*, *C. voigtii* or *C. cristata* and members of the *C. filamentosa* species complex. The type is unusual in having petals with an osmophore and an entire labellum. We have yet to see a plant that matches the type in these attributes. Some plants derived from a *C. sigmoidea* x *C. incrassata* cross have petals with an osmophore and approach the type. However, neither of these species has been collected as far west as the type locality of *C. x lavandulacea* between York and Narrogin.

Caladenia x ornata Hopper & A.P. Br., *hyb. nov.*

A *Caladenia x enigma* Hopper et A.P. Br. lamina labelli prominenter trilobata, marginibus integris vel minute serratis, et callis extensis e basi tantum circa in dimidio inferiore laminae differt.

Typus: south-east of Pithara, Western Australia, 9 September 1988, A.P. Brown 869 (*holo:* PERTH 01825690).

Differs from *Caladenia x enigma* Hopper & A.P. Br. in its labellum lamina prominently 3-lobed, with entire or minutely serrate margins, and calli extending from the base only about half the length of the lamina. (Figure 76)

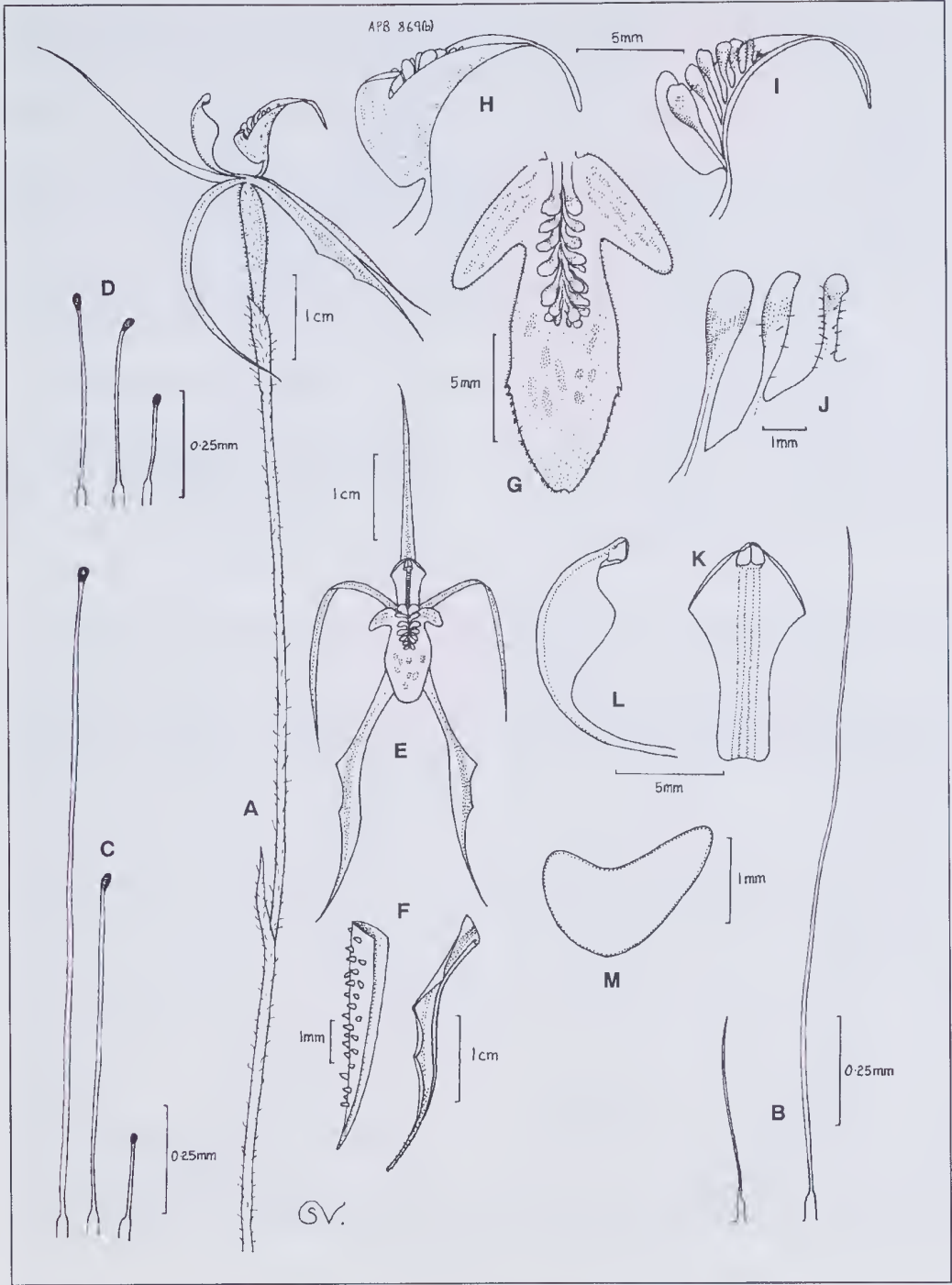


Figure 76. *Caladenia x ornata* from south-east of Pithara, A.P. Brown 869. A – plant; B – leaf hairs; C – hairs from lower scape; D – glandular hairs on ovary; E – flower from front; F – hairs on tepals; G – flattened labellum from above; H – labellum from side; I – longitudinally sectioned labellum from side; J – labellum lamina calli; K – column from front; L – column from side; M – pollinia. Drawn by C. Vasilu.

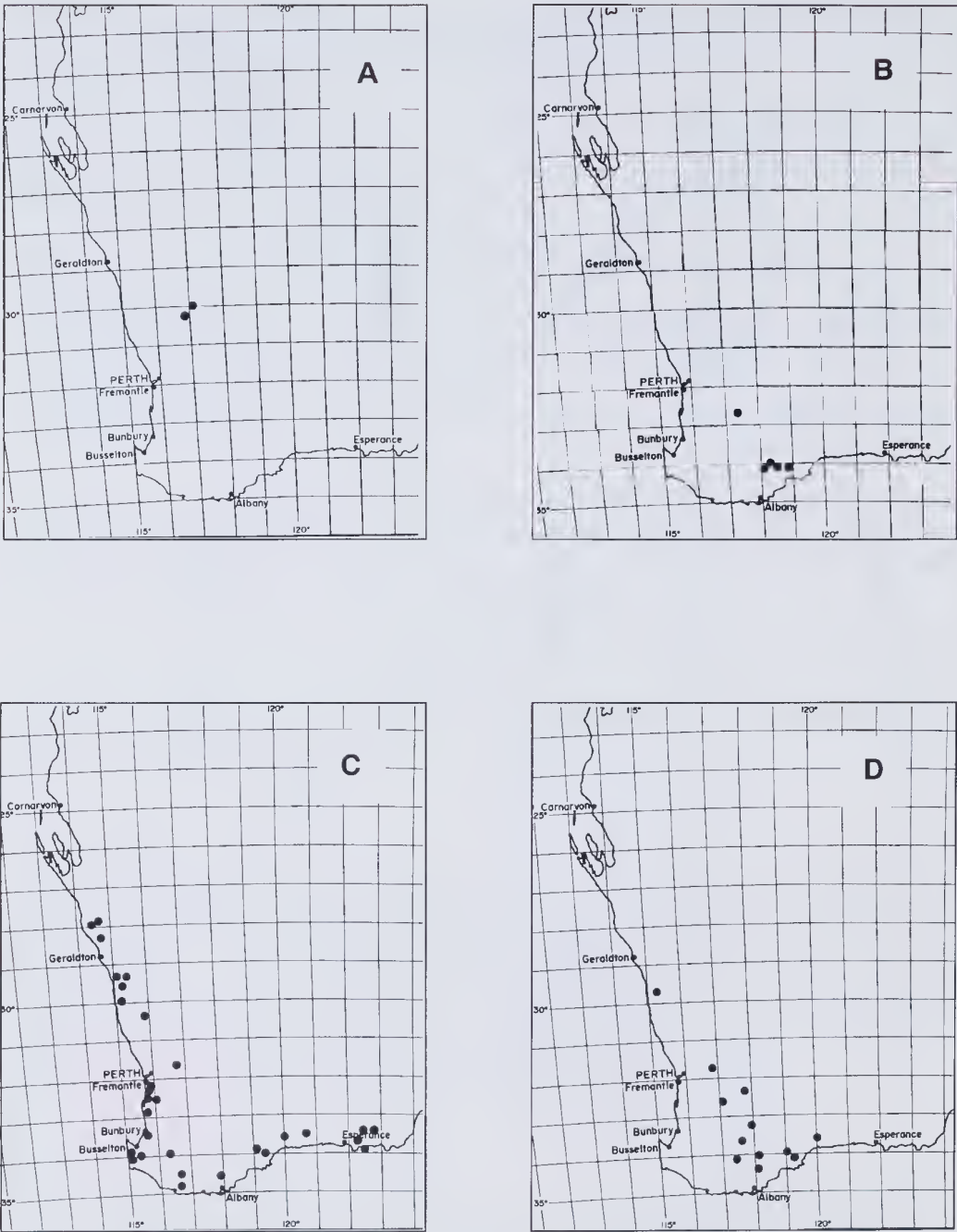


Figure 77. Distribution maps. A – *Caladenia x ornata*; B – *C. x resupina*; C – *C. x spectabilis*; D – *C. x suffusa*.

Distribution and habitat: Known from just two locations, near Pithara and west of Miling, growing on sandy rises above saline flats. (Figure 77A)

Flowering period. Late August to September.

Etymology. Named from the Latin *ornatus* (furnished, embellished), alluding to the labellum which is furnished with conspicuous lateral lobes and a dark rusty red colouration.

Notes. Represented in herbaria by the type collection only. *Caladenia x ornata* is an extremely rare but very distinctive hybrid, known from just two locations each with only one or two colonies. It is derived from hybridization between *C. exilis* and *C. drakeoides*.

Caladenia x resupina Hopper & A.P. Br., *hyb. nov.*

A *Caladenia multiclavia* H.G. Reichb. sepalis lateralibus longioribus, labello majore et columna brevior prominenter alata ad 15 mm elata differt.

Typus: 5 km south of Jerramungup, 5 km north of Carlawillup Rd, 33°58'S, 118°56'E, Western Australia, 5 October 1984, S.D. Hopper 4210 (*holo*: PERTH 00254681).

Differs from *Caladenia multiclavia* H.G. Reichb. in its longer lateral sepals (to 6 cm), larger labellum (to 15 x 13 mm), and shorter less prominently winged column to 15 mm tall. (Figures 75B)

Distribution and habitat. *Caladenia x resupina* is a rarely seen taxon distributed through the western and southern wheatbelt between Jerramungup and Popanyinning. It favours areas of open Wandoo woodland under scattered Rock Oak. (Figure 77B)

Flowering period. September to October.

Etymology. Derived from the Latin *resupinus* (bent back or backwards), alluding to the position of the dorsal sepal and column in fresh flowers.

Notes. Represented in herbaria by the type collection only. *Caladenia x resupina* is a distinctive rare hybrid derived from crosses between *C. multiclavia* and *C. horistes*.

Caladenia x spectabilis Hopper & A.P. Br., *hyb. nov.*

A *Caladenia flava* R. Br. floribus roseis vel armeniacis differt.

Typus: Munglinup River crossing on Rawlinson Rd, c. 20 km north-north-west of Munglinup, 33°33'S, 120°46'E, Western Australia, 24 September 1988, A.P. Brown 892 (*holo*: PERTH 01669575; *iso*: AD!, CBG!).

Illustrations. D. Jones, Native Orchids of Australia, pp. 10–11 (1988); K. Dixon, B. Buirchell & M. Collins (eds), Orchids of Western Australia – cultivation and natural history, colour plates b & c opposite p. 15 (1989).

Differs from *Caladenia flava* R. Br. in its variable pink to apricot floral colouration.

Selected specimens examined. WESTERN AUSTRALIA: island at Duke of Orleans Bay, 7 Sep. 1979, A. Brown s.n. (PERTH 00307025); Broke Inlet, near Camfield townsite, 12 Oct. 1969, A.S. George s.n. (PERTH 00682152); 18 km E of Dongara along north side of railway, 29°13'S, 115°04'E, 25 Aug. 1983, S.D. Hopper 3366 (PERTH 00249815); Dwellingup, 14 Sep. 1975, G. Hos 20/9 (PERTH 00246328).

Distribution and habitat. Widespread in near coastal areas between Esperance and Kalbarri. Occurs in a variety of habitats including coastal heaths, Peppermint woodlands, Jarrah and Karri forests, and granite outcrops. (Figure 77C)

Flowering period. August to October.

Etymology. Derived from the Latin *spectatus* (esteemed, worthy, excellent), alluding to the handsome flowers.

Notes. *Caladenia x spectabilis* is a colourful and not uncommon clonal hybrid derived from a *C. flava* x *C. latifolia* cross.

Caladenia x suffusa Hopper & A.P. Br., *hyb. nov.*

A *Caladenia hirta* Lindl. floribus majoribus sepalis lateralibus longioribus ad 4 cm longis differt.

Typus: Pallarup Rock Nature Reserve, Pallarup Rock, 44.5 km north-north-west of Ravensthorpe, 33°15'S, 119°45'E, Western Australia, 6 September 1984, S.D. Hopper 4098 (*holo:* PERTH 00254665).

Differs from *Caladenia hirta* Lindl. in its larger flowers with longer lateral sepals (to 4 cm). (Figure 75C)

Other specimen examined. WESTERN AUSTRALIA: Tunney, 34°07'S, 117°22'E, 28 Sep. 1977, A.S. George 14952 (PERTH 00934461).

Distribution and habitat. Found along the western and southern margins of the wheatbelt, where it is most common in areas of open Wandoo or Jam woodland. Soils vary from deep sands to sandy-clays and loams. (Figure 77D)

Flowering period. August to October.

Etymology. Derived from the Latin *suffusus* (tinged), alluding to the flowers which are white, often suffused with pink.

Notes. *Caladenia x suffusa* is a common hybrid of *C. hirta* and *C. longicauda*.

Caladenia x triangularis R. Rogers, *Trans. & Proc. Roy. Soc. South Australia* 51: 10 (1927). *Type:* between Wagin and Narrogin, Western Australia, September 1924, B.T. Goadby s.n. (*holo:* AD!).

Illustrations. S. Patrick & S. Hopper, A Guide to the Gazetted Rare Flora of Western Australia, Suppl.

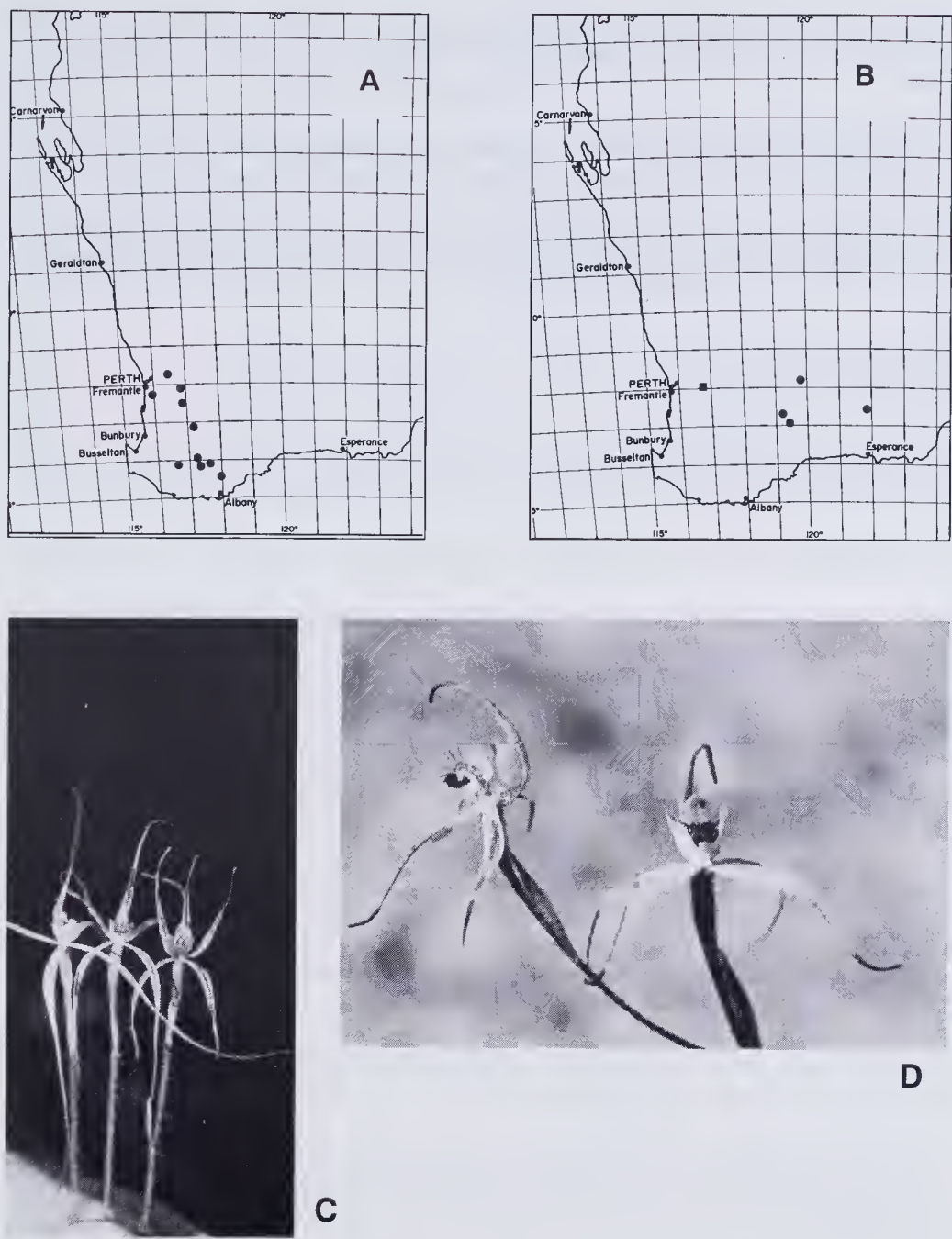


Figure 78. A – Distribution map of *Caladenia x triangularis*; B – Distribution map of *C. x tryphera* ● and *C. williamsiae* ■; C – *C. x tryphera* (centre) with parental taxa *C. microchila* (left) and *C. sigmoidea* (right) from the Lake King area, photograph by S.D. Hopper; D – *C. williamsiae* from type material, photograph by A.P. Brown.

1, Dept Fish. Wildl. Rept No. 54, p. 31 (1981); N. Hoffman & A. Brown, Orchids of South-West Australia, 1st edn, p. 70 (1984); C. Woolcock & D. Woolcock, Australian Terrestrial Orchids, p. 42 (1984).

Differs from *Caladenia flava* R.Br. in its larger creamy white to pale yellow flowers with lateral sepals to 5 cm long.

Other specimens examined. WESTERN AUSTRALIA: N of Dinninup, 5 Oct. 1983, *E. Chapman s.n.* (PERTH 00252271); Pingelly, 22 Sep. 1962, *K. Fletcher s.n.* (PERTH 00252263); Highbury, Oct. 1924, *B.T. Goadby s.n.* (PERTH 00261416); *s. loc.*, 1959, *R. Oliver s.n.* (PERTH 00252255); c. 10 m i l e s [16 km] SW [SE?] of Mayanup on road to Chowerup, 34°03'S, 116°33'E, 3 Oct. 1970, *C. Woolcock s.n.* (PERTH 00252247).

Distribution and habitat. WESTERN AUSTRALIA: Of scattered occurrence between the Stirling Range and Clackline. Usually found in open Wandoo woodland but also seen on one occasion in *Banksia* woodland. Soils vary from sandy-clay to lateritic loam. (Figure 78A)

Flowering period. August to October.

Notes. *Caladenia x triangularis* was regarded as an obscure species by several authors until Hoffman & Brown (1984) suggested it was a hybrid of *C. flava* and *C. longicauda*. This view has been followed by subsequent authors (e.g. Jones 1988; Clements 1989).

Caladenia x tryphera* Hopper & A.P. Br., *hyb. nov.

A *Caladenia microchila* Hopper & A.P. Br. sepalis lateralibus brevioribus ad 3.5 cm longis et labello apice atrorubro differt.

Typus: 1.5 km south of Varley crossroads on road to Purnta Rock, 73 km south-east of Hyden, 32°49'S, 119°01'E, Western Australia, 6 September 1984, *S.D. Hopper* 4091 (*holo:* PERTH 00254223).

Differs from *Caladenia microchila* Hopper & A.P. Br. in its shorter lateral sepals (to 3.5 cm long) and its labellum with a dark red apex. (Figure 78C)

Selected specimens examined. WESTERN AUSTRALIA: Parker Range, SE of Southern Cross, 30 July 1969, *A.S. George* 94319a–g (PERTH 00682187).

Distribution and habitat: Found from Grasspatch, north of Esperance to the Holt Rock area. Occurs beneath melaleuca thickets or in *Dodonaea/Olearia muelleri* low heath in mallee or woodlands on clay loams. Associated eucalypts at the type locality were *E. salubris*, *E. gracilis* and *E. longicornis*. (Figure 78B)

Flowering period. August to September.

Etymology. Derived from the Greek *trypheros* (dainty, delicate), alluding to the small delicate flowers.

Notes. *Caladenia x tryphera* is a diminutive hybrid of *C. microchila* and *C. sigmoidea*.

Notes added in proof

1. Lectotypification of *Caladenia* sect. *Calonema*

When making the new combination for *Caladenia* subg. *Calonema*, Hopper & Brown (2000: 124) made an incorrect bibliographic reference to Bentham as the author of the basionym. The lectotype chosen by Hopper & Brown (*loc. cit.*), *C. patersonii* R. Br., cannot be used because Lindley (1840) did not include that species in his treatment. The neolectotype, *C. longicauda* Lindl., is chosen because it best matches the protologue among the five species cited, and it is the only species illustrated by Lindley (1840).

The taxon *Caladenia filifera* Lindl., indicated as "Type species" by Jones (2001: 91) for *Caladenia* sect. *Calonema* Lindl., is also here superseded because it is in conflict with the protologue in not having fimbriate labellum margins. Also, if Jones' typification were to be accepted, a new name would be required for our concept of *C. subg. Calonema*, the traditional application of the name *Calonema* would be over-ridden, and the name *C. subg. Phlebochilus* would become a synonym of subg. *Calonema*, again confusing traditional usage.

2. A distinctive new species of *Caladenia* subg. *Calonema*

Caladenia williamsiae Hopper & A.P. Brown, *sp. nov.*

A speciebus ceteris gregis *C. longiclavata* E. Coleman petalis sepalisque saepe flavo-virentibus cum maculis rufescentibus, sepalis lateralibus 1.5–2.0 cm longis et 2–2.5 mm latis cum clavis 3–4 mm longis, petalis rigidis, 1.5–2.0 cm longis et 1.5–2 mm latis, lacking osmophores, labello 6–8 mm longo et 3–4 mm lato, labelli fimbria ad 3 mm longa differt.

Typus: Brookton area, Western Australia, 15 August 2000, *J. Williams s.n. (holo: PERTH)*.

Plant usually solitary. *Leaf* erect, broadly linear, 7–9 cm x 15–18 mm, pale green, basal third irregularly blotched with red-purple. *Scape* 15–20 cm tall. *Flowers* 1 or 2(3), c. 3 cm across, predominantly yellow green with variable suffusions, lines and spots of dull maroon; floral odour unknown. *Sepals and petals* stiffly held, the sepals linear in basal half, then abruptly narrowing for 5–7 mm before expanding to an osmophore; osmophore elongate, tumescent, dull maroon, 3–4 mm long, consisting of minute densely packed globular sessile glandular cells. *Dorsal sepal* erect and incurved, 1.5–2 cm x 1–1.5 mm. *Lateral sepals* straight with apex spreading obliquely downwards, 1.5–2.0 cm x 2–2.5 mm. *Petals* straight, horizontal with a slightly downcurved apex, 1.5–2.0 cm x 1.5–2 mm. *Labellum* 3-lobed, prominently 2-coloured, yellowish-green to cream with pink to dull maroon radiating stripes, terminating in a uniformly dark maroon recurved apex, stiffly articulate on a claw c. 1.5 mm wide; lamina narrowly cordate with an acute apex in outline when flattened, 6–8 x 3–4 mm, basal third curving from erect to oblique, middle third ascending, apical third sharply recurved, margins at widest point scarcely curved upwards and terminated by ascending calli; lateral lobes erect to obliquely ascending with entire margins near the claw, becoming fimbriate with slender slightly clubbed linear cream to dull maroon calli to 3 mm long which are abruptly decrescent near midlobe; midlobe margins with short slender slightly forward-facing obtuse sometimes hooked calli decrescent towards the apex. *Lamina calli* in 2 pairs of rows (with a clear gap between them) extending at least 3/4 the length of the labellum, dark maroon, slightly falcate and capitate, the longest c. 1 mm

tall, decrescent towards apex and becoming sessile. *Column* 7–8 x 2–3 mm, narrowly winged, dark dull maroon with pale yellow blotches. *Anther* c. 1.5 x 1.5 mm, yellow-maroon. *Pollinia* not seen. *Stigma* c. 1.5 mm wide, dark dull maroon. *Capsule* not seen. (Figure 78D).

Distribution and habitat. Recorded from a single locality in the Brookton area in open Wandoo/Jarrah woodland over scattered open shrubs in red loamy soil.

Flowering period. August to early September.

Etymology. Named for the discoverer and collector of the type.

Notes. *C. williamsiae* was discovered in 1999 by Mrs Judy Williams near Brookton and is known only from the type material (Priority Two). Only 12 plants are known from the type locality, which is on a nature reserve.

In the absence of DNA data, it is difficult to identify relationships of *C. williamsiae*. Its short broad leaf, and small greenish-yellow flowers with four rows of calli on the labellum and sepals abruptly narrowed above the osmophore are characters not seen elsewhere in *C.* subg. *Calonema*. The dark colouration of the plant overall makes it difficult to locate in the wild.

3. Szlachetko's (2001) new genera, sections and combinations not supported

Szlachetko (2001) recently erected a range of new genera with consequent new combinations in the subtribe Caladeniinae Pfitz., essentially raising taxa we recognise herein as subgenera of *Caladenia* to full generic status, as well as creating the new monotypic genus *Jonesiopsis* Szlach. for *Caladenia multiclavia* Reichenb. f. The only justification for this and other similar concepts for splitting long-established genera such as *Pterostylis*, *Chiloglottis* and *Acianthus* was a statement that "in completing materials to *Gynostemia Orchidaleum* and to the first volume of *Genera et Species Orchidaleum* I came to the conclusion that several groups of orchids are very heteromorphic and should be divided into smaller but monomorphic taxa".

There is no reference by Szlachetko (2001) to contemporary research on these genera other than to Hoffman & Brown's (1998) field guide. Insights gained from DNA sequence studies such as that of Kores *et al.* (2000) are not cited. Only herbarium specimens mainly in Europe, the United Kingdom and the USA have been examined, although none other than types are cited.

In the absence of compelling new evidence, therefore, and in view of the unnecessary nomenclatural upheaval that flows from Szlachetko's (2001) concepts, we do not support his new genera nor his new combinations. Thus, the following genera we regard as synonyms of *Caladenia* R. Br.: *Jonesiopsis* Szlach. [also given incorrectly in the same publication as *Jonesiella*], *Phlebochilus* (Benth.) Szlach., and *Calonema* (Lindl.) Szlach. The new genus *Pentisea* (Lindl.) Szlach. is a synonym of *Cyanicula* Hopper & A.P.Br. All combinations made under these new genera we regard as synonyms for the respective species of *Caladenia* and *Cyanicula*. *Caladenia* section *Caladeniastrum* Szlach. is a synonym of the previously published *Caladenia* subg. *Elevatae* Hopper & A.P.Br.

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CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

R: Declared Rare Flora – Extant Taxa (= Threatened Flora = Endangered + Vulnerable)

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

X: Declared Rare Flora – Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Threatened Species Scientific Committee.

1: Priority One – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two – Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three – Poorly Known Taxa

Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years.

Notes for Authors

The aim of *Nuytsia* is to publish original papers on systematic botany with preference given to papers relating to the flora of Western Australia. All papers are refereed and the Editorial Advisory Committee reserves the right to reject papers. Opinions expressed by authors are their own and do not necessarily represent the policies or views of the Department of Conservation and Land Management.

After final acceptance of papers, authors are requested to provide discs readable directly by IBM computer or internet attachments. Wherever possible, the MS-WORD software should be used. Original figures should not be lettered but accompanied by copies indicating lettering. Page proofs will be forwarded to authors for checking. Twenty reprints of each paper will be provided free of charge; no additional copies may be ordered.

Style and layout should follow recent numbers of *Nuytsia*. Within a paragraph two spaces are required between sentences; after colons, semicolons, commas and dashes a single space is required. Italics should be used for formal taxonomic names, from the genus level down to the lowest infraspecific categories, and for collectors' names when citing specimens. Incidental Latin words in the text should be italicized but not the Latin diagnosis.

Title. Should include the family name of the genera or species treated, but not authorities. New taxa should be named if not too numerous. The type of paper (e.g. revision, synopsis) and geographic area of study should be given where appropriate.

Structure of papers. Authors are encouraged to use the conventional structure of scientific papers, especially when a complete study, such as a revision, is being reported.

(1) **Abstract.** Should be indented and commence with bibliographic information. New taxa, combinations and names should be listed with their authorities. The major contents of the paper should be concisely summarized but no additional material given.

(2) **Introduction.** Should give some background information and state the purpose of the paper.

(3) **Methods or Materials and methods.** May include the method of drawing up the description from specimens, extent of search for types and discussion of concepts of taxonomic categories.

(4) **Results or Taxonomy or Taxonomic treatment** or various alternative headings as appropriate to the data being presented in the paper.

(5) **Discussion.** A discussion section should be considered, which would include some or all of the following: a summary of the findings emphasizing the most significant; interpretation of the results in the light of other relevant work; statement of new problems which have arisen; advising of aspects which are to be followed up; suggestion of topics which others might usefully pursue; prediction and speculation.

Short Communications. These are short concise contributions, usually with few or no main headings. They lack an abstract and authors' names and addresses are placed at the end.

Headings. All headings should be mainly in lower case, major headings centred and bold, secondary headings (where required) left-justified and bold, and minor headings left-justified and italicized.

Keys. May be either indented (e.g. *Nuytsia* 11: 94) or bracketed (e.g. *Nuytsia* 11: 55–56). Indented keys involving more than nine levels of indentation should be avoided. Where a key is indented, tabs should be used and not space bars.

Species treatments. Use of certain named paragraphs, or sets of paragraphs, for matter following the descriptions is encouraged. The desired sequence and examples of commonly used headings are shown below. Italicized headings should be followed by text on the same line.

(1) Taxon name (in bold) and authority. For previously published taxa this should be followed by the reference, nomenclatural synonyms (if any) and *Type*: heading with full type details.

(2) Other synonyms with their type details, significant manuscript or phrase names. Recent papers should be consulted for examples of an appropriate format for citing synonyms.

(3) Latin diagnoses (for new taxa – not indented).

(4) *Typus*: (for new taxa – not indented).

(5) English description (indented).

(6) *Other specimens examined* or *Selected specimens examined* as appropriate. The number of specimens cited for each taxon should not exceed 20. Western Australian specimens should be cited first followed by any from other states in the order: Northern Territory, South Australia, Queensland, New South Wales, Victoria, Tasmania. Within each region, the specimens cited should be placed in alphabetical order according to the collectors' surnames. For each specimen the order of the details given should be as follows: locality, date, collector's name (in italics) and number, herbarium (in brackets).

(7) *Distribution*.

(8) *Habitat*.

(9) *Phenology* or *Flowering period*.

(10) *Conservation status*. Department of Conservation and Land Management Conservation Codes for Declared Rare and Priority Flora should be cited for any endangered or rare Western Australian plants.

(11) *Etymology*.

(12) *Typification*.

(13) *Affinities*.

(14) *Notes* or *Discussion* or *Comments*.

Threatened species. The Department of Conservation and Land Management has a policy not to publish precise locality data for threatened species. When describing threatened taxa authors are therefore requested to use generalized localities accompanied by the bracketed statement [precise locality withheld].

Standard abbreviations. When abbreviations are used, the following standards should be followed.

(1) Author abbreviations. Follow Brummitt, R.K. & Powell, C.E. (1992). "Authors of Plant Names." (Royal Botanic Gardens: Kew.).

Book titles. These should not be abbreviated in the references but any literature citations in the text should follow Green, J.W. (1985). "Census of the Vascular Plants of Western Australia." 2nd edn. pp. 20–24. (Department of Agriculture: Perth.). A more complete list of book title abbreviations is given in Stafleu, F.A. & Cowan, R.S. (1976–83). "Taxonomic Literature." 2nd edn. (Bohn, Scheltema & Holkema: Utrecht.), but capital initial letters need to be used in *Nuytsia*.

(3) Journal titles. Follow Lawrence, G.H.M. *et al.* (1968). "B-P-H. Botanico-Periodicum-Huntianum." (Hunt Botanical Library: Pittsburgh.)

(4) Dates and directions. Generally should not be abbreviated except under the *Specimens examined* section. In that section, dates should be written in full only if they have less than five letters (e.g. July), otherwise should be shortened to the first three letters and a stop (e.g. Oct.), while compass directions should be abbreviated to capital letters with no stops (e.g. N and SSW).

(5) Other abbreviations. Standard abbreviations for measurements (e.g. mm), Latin abbreviations (e.g. *c.*, *nom. illeg.*), mountains and roads (e.g. Mt Kosciuszko, Brooke Rd) are used in *Nuytsia*. Other abbreviations, especially ones that are ambiguous (e.g. Pt), should be avoided.

Figures. Numbers should follow a single sequence including maps.

References. Citation of references in the text should give the author's surname and date (e.g. Smith 1963) and full details should be given in the reference section. This format is also recommended to replace the traditional abbreviations for references listed under taxonomic names, for example using Benth. (Benth 1878: 234) rather than Benth., Fl. Austral. 7: 234 (1878).

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